HANDBOOK

BRITISH ASSOCIATION

BRADFORD 1900

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

HANDBOOK TO BRADFORD

AND THE

NEIGHBOURHOOD.

PREPARED BY VARIOUS CONTRIBUTORS FOR THE PUBLICATIONS COMMITTEE.

EDITED BY R. M. WHEELER, M.A.

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PREFACE.

This Handbook to the City of Bradford and the neighbourhood has been prepared for the use of Members and Associates of the British Association for the Advancement of Science, on the occasion of the visit of the Association to Bradford, September 5th—12th, 1900.

The work was undertaken by the local Publications Committee, at whose request Mr. Arthur Burrell, M.A., kindly undertook the editorship. In the selection of contributions the Committee have been desirous that each department should be dealt with by one who, by local and technical acquaintance with the subject, was most fully qualified to speak with accuracy and authority.

Upon Mr. Burrell's removal to Isleworth in January, to assume the principalship of the Borough Training College, I was asked to take up the Secretaryship of the Publications Committee and the preparation of this Handbook for the press. I heartily thank the numerous contributors for the ungrudging and painstaking labour which they have expended, and I venture to hope that, as the result, this Handbook may not only prove interesting

and useful to those for whom it is primarily intended but may also serve as a valuable permanent record of the historical, social, and scientific features of the City of Bradford at the close of the nineteenth century.

R. MORTIMER WHEELER.

HURST GARTH, SHIPLEY,
August, 1900.

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Page 7.	Substitute	"Marley" for "Morley."
,, 9.	,,	"Oswin" for "Otwin."
,, 19.	,,	"*Ancient*" for "*Singular*."
,, 20.	,,	"Riens" for "Rienes."
,, 21.	,,	"Riens" for "Reines."
,, 44.	,,	"Marley" for "Morley."
,, 44.	,,	"*Ham*" for "*Tarn*."
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BRADFORD.

I.—HISTORICAL SECTION.

I.—PRE-HISTORIC AND PRE-NORMAN ARCHÆOLOGY.

By BUTLER WOOD.

It has been suggested that the absence of specific traces of any primitive habitation of Bradford may be due to continuous occupation, and the consequent effacement of the earlier unwritten record by cultivation and the changes incidental to it. But if from Bradford itself the traces have disappeared under the feet of successive generations, the immediate neighbourhood abounds in the remains of primitive life. The hills around are crested with barrows, earthworks, and stone circles; the rocks and moor-boulders are inscribed with cup-and-ring markings, swastika, and other primitive signs; while the surface of the moor and the fields under cultivation have been prolific in the yield of flint implements. At whatever time Bradford itself may have come into being as an individual community, it came as the centre and focus of a district well peopled from time immemorial.

By far the most interesting area in this locality is that known as Rumbald's Moor—which may here be taken to include the moors of Morton, Baildon, Hawksworth, and Burley—a stretch of uncultivated country lying between

the Wharfe and Aire valleys, limited on the west by the cultivated districts of Bolton and Skipton, and on the east by those of Burley and Hawksworth. In no part of this area is there any trace of palæolithic man, but the evidences of late neolithic occupation are plentiful enough. Flint and stone implements have been occasionally found on the moors around Halifax, Keighley, and Huddersfield, but Rumbald's Moor has yielded the largest number. Many have been turned up by the plough on the cultivated fringes of the moor, but the most numerous finds have been made on the bare surfaces of the moor itself. These implements consist of arrow-heads, spear-heads, knives, scrapers, awls, and small flint saws—many of the specimens being exquisitely chipped. From the large quantity of chippings and unfinished implements found near the Grubstones Shooting Box, and also in a field near Gilstead, it is probable that both these places were, in some sense, local centres of the flintman's craft. The arrow-heads are mostly of the stemmed and barbed type, and appear identical in character and material with those found on the Yorkshire Wolds. With the exception of an arrow-head found in Bowling, no flint implement has been discovered within the limits of the city boundary. Perhaps the finest example yet unearthed in the neighbourhood is a celt, six inches long, exquisitely chipped, found at Gilstead and now in the possession of Mr. W. Cudworth. At this village Mr. J. E. Preston has found an arrow-head which shows traces of polishing. The most common form of implement is that known as the scraper, many of the examples being very small, and carefully worked. The nodules from which all these flint implements have been fabricated have evidently been brought from the East-Riding, a distance of at least 50 miles.

A few bronze implements have been discovered in the district. The most interesting is a collar 6 inches in diameter and weighing 10½ ounces, found at Embsay, near

Skipton, in 1845, imbedded between two upright slabs of stone. Bronze celts have been found at Low Baildon, Gilstead Moor, and Rawdon Billing. At the latter place Wardell records the discovery of a gold torc of Keltic workmanship, which was supposed to have been claimed by the Lord of the Manor.

Leaving these weapons and ornaments of the living, we turn to the burial places of the dead. Rumbald's Moor bears on its surface a large number of these barrows and cairns. They are all of the round type, and, unfortunately, nearly all disturbed. The walls in their vicinity are bristling with stones, many of them burnt, which have obviously been taken from the burial mounds. Even the stone circles have been mutilated to provide gate-posts and "throughs" for the walls. The largest and most interesting mounds are situated on Burley Moor, lying to the south-east of Ilkley. The "Great Skirtful of Stones" measures 85 feet in diameter and is from 4 to 6 feet high. It has been badly mutilated, but never systematically explored. Burnt stones are visible near the middle of the pile. Half a mile to the north of this lies the "Little Skirtful of Stones," a similar, but rather smaller, mound. Half a mile east of the "Great Skirtful" is another nearly as large. It appears to have been disturbed, as there are traces of an oblong excavation in the middle. Adjacent to this mound at least fifty small heaps may be seen, many consisting of a few boulders only, but all evidently of pre-historic origin. Several of them have been examined by Mr. J. E. Preston, of Gilstead, but without result. Coming nearer Bradford, it is interesting to find a record of the opening of some barrows at Dobrudden farm in 1845, by Mr. J. N. M. Colls. In one of these he found two urns containing burnt human remains and a flint arrowhead. Mr. H. Speight, in his work on "Airedale," also mentions the existence of an unopened barrow, 30 feet in diameter, at the same place. Two years ago the writer assisted Mr. Mortimer Wheeler and Mr. W. Cudworth in

exploring two barrows on Kildwick Moor, but no traces of interment were found, excepting a quantity of burnt stones. In addition to the barrows already alluded to, there are some disturbed ones at Counter Hill, Addingham, but there is no record of any results. Quite recently some twenty barrows have been discovered on Harden Moor, near Bingley. They vary from 40 to 8 or 10 feet in diameter. Many of these would probably repay examination.

There are also many examples of Stone Circles distributed over the area now under consideration. The largest, near the City, is that situated at Bracken Hall Green, on the western slope of Baildon Hill, about four miles from Bradford. It consists of a double row of stones, measures 137 yards in circumference, 50 yards from north to south, and 39 yards from east to west. Unfortunately the eastern end is almost obliterated by an old roadway which passes over it on that side. Perhaps the best existing example is that near Hornscliffe Shooting House. This is also a double circle, the stones varying from 3 to 5 feet in height, and its diameter is 43 feet. There is a smaller circle on Burley Moor, consisting of 12 upright stones. The finest stone circle in the Rumbald's Moor area was demolished some four or five years ago, when the reservoir was made at Weecher. It measured 27 yards in diameter. Another circle is to be seen near the "Great Skirtful of Stones" already alluded to. In order to complete the record it is necessary to mention a small circle on the right-hand of the path leading from Eldwick to Ilkley, at the point where it passes over the summit of the ridge and near the upright stone known as the "Lanshaw Lad." Two other circles are worthy of note: one near the Grubstones Shooting-box, and another on Rivock Edge, at the north-western end of the moor, the latter containing a cup-and-ring-marked boulder in the centre.

The cup-and-ring mark just referred to is exceptionally frequent in this district. Some years ago, Mr. J. E. Preston

observed markings of this character on several boulders on the western slopes of Baildon Hill. An interesting marking was visible some years ago on a rock surface at Bracken Hall Green, but it was destroyed by an itinerant showman who built his fire over it. Mr. Romilly-Allen has recorded many inscribed rocks on the Northern slopes of Rumbald's Moor, and these he has described in the "Reliquary" for 1896. Some are to be seen near the Cow and Calf rocks, Ilkley, Addingham Crag, and the Doubler Stones; but the most interesting are undoubtedly those formerly on the Panorama Rocks, Ilkley. The slabs on which the markings are inscribed have been removed to a site close to St. Margaret's Church, and protected by an iron fence. At Woodhouse Crag and Grainings Head, markings of a swastika shape are found side by side with the usual cup-and-ring inscriptions. The only cup-and-ring-marked stone noted upon the Bradford side of the valley in the immediate neighbourhood of the city—and one which is at a considerably lower elevation than the rest of the series—is to be found below the Nab Wood.

In Mr. Colls' account* of his exploration of some barrows at Dobrudden, Baildon, he records the finding of traces of earthworks running parallel to each other at distances from 50 to 80 yards apart, and intersected by other works of similar construction. These are unfortunately now obliterated, but there still exists on the north side of Baildon Hill the angle of an intrenchment, consisting of a fosse, with agger 2 feet 4 inches high. The long side measures 80 feet, and the short side 36 feet. At Counter Hill, near Addingham, is an oval-shaped camp, the longer axis measuring 300 feet, and the shorter 250 feet in length. The trench outside the Vallum is 15 feet wide and 4 feet deep. Half a mile south of this is a similar camp, 440 feet by 275 feet, with a surrounding ditch. Mention

* "Archæologia," Vol. xxxi.

may also be made of some ancient enclosures lying about half a mile north of Lanshaw Delves. Of these, some are rectangular, and some oval, in form; they are composed of walls of earth and boulders rising a few feet above the ground. The area covered by them measures about 100 yards by 40 yards. The most striking earthwork in the neighbourhood of Bradford, however, is to be found, not on Rumbald's Moor, but on Catstones Moor, near Cullingworth. It encloses the crest and slope of a hill, and measures 266 yards on the east side (which is perfect), and 100 yards on the north side; the latter, however, being traceable at least 100 yards further, across a cultivated field. The south side is almost obliterated by quarries, while the western portion has disappeared altogether. Half a mile north of this interesting pre-historic fortification, Mr. W. E. Preston and the writer traced a short time ago, on Harden Moor, remains of an intrenchment for a distance of 80 or 90 yards. It faces south and lies near Spring Head Heights. The wall consists of earth and boulders rising 3 feet above the soil, but there is no trace of a ditch.

Another phase of pre-historic life in this district is exemplified in the excavations known as "Pit Dwellings." Several are to be seen on the slopes of Baildon Hill, but more particularly near Dobrudden Farm. They are bowl-shaped cavities with a depth of about 10 ft., and a diameter of 20 ft. The fact of their being located on an outcrop of the Halifax coal shales has led some to believe that they are merely the result of some rude attempts at coal-getting, but there can be little doubt that they are the remains of primitive pit dwellings. In a field adjoining Addingham Moor there are no less than 50 of such excavations enclosed by an intrenchment. At Lanshaw Delves (a lateral moraine often mistaken for an earthwork), there is a triple row, and many others are scattered over the surface of Rumbald's Moor. It is worthy of note that springs of water are often found near these primitive dwellings.

The boundary line of the Historic and the Pre-historic is touched when we arrive at the evidences of the Roman occupation of Britain. This neighbourhood is not especially rich in such evidences, but those which remain are worthy of some notice. The Roman road from Manchester to Ilkley passed the western boundary of the city at Denholme, but there are no portions of the road now remaining, except at Blackstone Edge, and Ogden, near Halifax. In the middle of last century Warburton saw portions at Morton, Harden, and Denholme; and Dr. Richardson observed traces between Hainworth and Cullingworth. The road is supposed to have crossed the Aire at Morley, but all efforts to locate the ford have hitherto failed. The largest number of Roman coins ever found together were discovered at Morton in 1776. The collection consisted of a great quantity of denarii in excellent preservation, mostly of Septimius Severus, Julia Donna, Caracalla, and Geta. They were contained in the remains of a brass chest, probably belonging to a Roman legion, and buried here on some sudden alarm. The fate of the collection is unknown. Dr. Richardson states in his letters that about the middle of last century a number of copper coins were discovered under a cinder-heap at Bierley, near Bradford. Fragments of pottery have been found in great quantities on the site of the Roman camp at Ilkley. Mr. John Sunderland, of Skipton, has in his possession a perfect Samian bowl found here, but very few are known to exist. The other remains at this station are not numerous. Camden has recorded some inscriptions, which may be found transcribed in Turner's "History of Ilkley." The following sculptured stones have been found on this site:—Roman Altar and Tombstone, now at Middleton Lodge; fragment of a Tombstone, now at Arncliffe; Tombstone and Milestone, now in the Museum at Ilkley.

Two points of interest should be noted in connection with the ancient remains in the district, although there is

some doubt as to their antiquity, the traces of rude Bloomaries, and a track-way of supposed pre-Norman origin. Of the former, there are indications in the shape of heaps of scoriæ containing a large percentage of unsmelted iron at Low Moor, Holden Gill, and on the north side of Baildon Moor; while an ancient causeway, leading from Hope Gate to Dobrudden, is still visible for a distance of about 50 yards, when it becomes buried in the débris of some coal workings. The track is supposed, by Mr. Harry Speight, to be the remains of a British road from Dewsbury to Ilkley.

In pre-Norman times the Bradford parish was situated in the province of Deira, and formed part of its western boundary. It would be in accordance with a very general principle of succession that a Keltic settlement should have preceded that of the Saxons who named the town, but there is no trace either pre-historic or historic of their presence. It may be desirable, however, to mention a few probabilities in default of a definite record. It is not unlikely that the Keltic inhabitants of this neighbourhood would first come into conflict with the Roman power when Publius Ostorius Scapula (A.D. 50) invaded Yorkshire from Chester. When Agricola completed the reduction of the North (A.D. 79) the district would be affected by his operations, and during the thirty-five years which succeeded his removal the Brigantian inhabitants would doubtless share in the tumults of the period, and also suffer with the rest of the North from the subsequent inroads of the Picts and Scots. About A.D. 450 the Saxon Ida ruled over Deira, and a century later it fell under the sway of Ælla. Notwithstanding the Saxon domination there is reason to believe that the population of the West Riding, in common with Cumberland, Westmoreland, Lancashire, and Cheshire, remained largely Keltic in character, for it is recorded that the tribes of these districts were banded in a confederacy under the title of "The Kymry" about A.D. 600. Loidis (Leeds) and Elmete are

also mentioned as two principalities about this period. Cerdic the Saxon was Prince of Elmete in A.D. 617, but he was expelled by Eadwine and his territory annexed. It is probable that about this time (A.D. 625) Paulinus would re-introduce Christianity into these parts. In A.D. 642 the inhabitants fell under the sway of Otwin, who became Lord of Deira, and who twelve years later defeated Penda in a great battle on the river Aire near Leeds. The district came under Danish authority A.D. 866, and ten years later Halfdene parcelled it out amongst his followers. The Danish place-names in the neighbourhood in all probability date from this period. The principal pre-Norman remains are the Runic monument at Bingley, and crosses with interlaced ornamentation at Ilkley.

II.—HISTORICAL RECORD TO THE EIGHTEENTH CENTURY.

By HARRY SPEIGHT.

Bradford, a city of nearly 300,000 inhabitants, had, up to quite recent times, neither the population nor the historic importance of many places of much less note at the present day. Its population was comparatively small (a century ago the whole parish had less than 30,000 inhabitants), and it was never one of those classic spots famed for the presence of some hoary abbey, castle, or time-honoured cathedral. Indeed the city itself possesses no ancient buildings of interest save the parish church, which at no distant date looked down upon green fields, ruddy orchards, and the clearest of rivulets (now a covered drain, but anciently the town's only source of supply), which has provided many a dainty dish of trout to persons even still living. The place is essentially of modern growth, due, as is well known, to the extraordinary development of its staple

industries—the wool and worsted trades. Leland, in the time of Henry VIII., had noticed that the town was "praty quik," and that quickness has proved the incentive to a marvellous advance in its material prosperity during the past hundred years. That sheep-raising early became an important concern of the neighbourhood is plainly to be gathered from local records; and whatever profits or benefits former lords of Bradford derived from tillage and the cultivation of corn, or whatever advantages accrued therefrom to their tenants, there is no doubt that the Wool King has long ruled the affairs of her free and industrious citizens, and has been the greatest benefactor Bradford has ever known.

Of the original founders of Bradford nothing can be said with certainty. The earliest allusion to the place is in Domesday, where it is written *Bradeford*. This is usually interpreted *broad ford*, though the beck in the town was very narrow—only a stride or two across: but perhaps in the first syllable of the word may lurk the name of the original owner or guardian of the ford, as also, perhaps, of the great wood which is called *Brashaw* in later charters, and which anciently covered the whole northern slope of the town. In such places as Knutsford, Hachforth, and Horsforth appear the names of original settlers by certain ancient fords; Brad or Brade is a well-authenticated Anglo-Saxon personal name, while one Brade appears as a benefactor to the neighbouring Abbey of Kirkstall, founded by Henry de Lacy, grandson of Ilbert de Lacy, to whom the manor of Bradford was granted on the Norman settlement.* By the Domesday Inquest we learn that the manor in the reign of the Confessor had belonged to one Gamel, who also owned other properties in Yorkshire, but Bradford with its six berewicks, then of the annual value of £4, was

* At the same time it may be noted that formerly the little beck may have much more frequently overflowed its banks than in recent times, and so have justified the designation "broad ford."

his chief estate, and probably his seat. On the Norman sequestration Bradford was given to Ilbert de Lacy, one of the most powerful adherents of the Conqueror, who obtained more than 200 manors in the West Riding, and was also lord of Blackburnshire. He was the builder of Pontefract Castle, his great Yorkshire stronghold. The manor of Bradford being merged in the Honour of Pontefract, then embraced not only the township of Bradford but six (unnamed) dependent berewicks, or cornvills, the whole comprising a taxable area of fifteen carucates worked by eight ploughs. Manningham and Stanbury (in the parish of Haworth) were undoubtedly two of these berewicks ; the others can only be conjectured. The manor extended as far west as Haworth, in length about ten miles, with a probable average breadth of three miles. It was declared all waste in the great Norman survey, and consequently was of no worth. But the term "waste" as used in Domesday does not, as is commonly supposed, necessarily imply destruction or annihilation ; it may also denote a severe degree of poverty. No church is of course recorded, and at this we cannot wonder, when the whole manor according to this description was unable to bear taxation. It has been contended that no church existed before the Conquest, but truth must surely rebel against the inconsistency of a manor and parish comprising probably 20,000 acres of land, and maintaining families that cultivated at least 2000 acres, being wholly without any place for the public worship of their Maker. That the Word of God was actually preached here is sufficiently attested by the presence of a fragment of a pre-Norman Christian cross, which had been used as a wall-stone in the church, and is now preserved in the present building.

Before the twelfth century had far advanced, Bradford no doubt shared something of the prosperity that was beginning to be felt in the lately-impoverished county, for the pipe rolls of Henry II. show that about A.D. 1140,

when a rate of 2s. a carucate was levied on the whole of Yorkshire to produce £160, there must then have been some 1600 carucates under annual cultivation. The Lacies, who continued to hold the manor of Bradford till the early part of the fourteenth century, cannot be said to have been hard on their tenants, or to have imposed on them anything more than the legitimate claims of ordinary feudal tenure. Stringent and exacting as these were in many respects, they were not less so to the lord himself, inasmuch as by feudal law the King was paramount owner of all land, while the lords of manors were but his tenants, bound to serve in the wars at their own expense, and even more liable to the loss of their estates than the inferior tenants themselves. For it was a recognised principle of the feudal system that no tenant, whether bond or free, might be removed from his holding, so long as he did not violate the obligations of fealty to his chief. In process of time, as population increased, these obligations became less irksome by the levy of assessments in lieu of service, while money was also raised by prerogative of the King compelling all able vassals to be knighted or to pay a fine. A tenure established on this basis undoubtedly gave in an era of comparative peace great opportunities for civil and social development, such as it was at that day.

By the middle of the thirteenth century Bradford had risen from the condition of a mere village to be one of the chief towns in Yorkshire. The fixity of tenure alluded to, together with the declining value of scutages, or fixed money-payments in lieu of service, rendered the condition of the thirteenth century freeholders indeed far from despicable, and when the time was ripe for constitutional changes towards the end of this century the whole body of freeholders was greatly advanced in social and political status. The town had now considerably expanded, and its productiveness had so much increased that Edmund de Lacy, lord of the manor, sought and obtained in 1251

licence from the King to hold markets weekly in the town. Although the market was chartered to be held on Thursdays, it seems usually to have taken place on Sundays, an arrangement that arose no doubt from the convenience it afforded to buyers and sellers and to those especially from remote parts of the parish, as enabling them to attend the church services at the same time. More people were also about on these occasions, which was a consideration of some moment when the roads were so notoriously infested with thieves, that it became necessary at this time to remove all bushes and other screen for a distance of 200 feet on each side of every public road leading from one market town to another. By an inquisition touching the lord's liberties of the manor in 1277 it appears that a free-court had existed here "from ancient times." The inference might be drawn that it primarily existed as the village council perhaps as long ago as the time of Alfred, whose policy it was to bring justice home to every man's door, by constituting as many courts of judicature as there were townships in the kingdom; at any rate it originated long before a Parliament assembled to impose taxes and formulate laws for the whole kingdom, and the fact of its existing at Bradford at this remote period is a certain indication of popular liberty as well as of manorial prestige. The lord's bailiffs levied the King's debts, and in the usual catalogue of manorial rights and privileges it is stated that he had a prison, and claimed escheat of all criminals executed within his jurisdiction. Though in an altered form this was but the survival of a custom long ante-dating the Norman feudal system, and that it was by no means effete at this time is evidenced by an entry in the bailiff's accounts for 1295 of 6d. "spent on making gallows for criminals." It is conjectured that these gallows stood somewhere near the present Bowling Iron Works, as an ancient enclosure there bore the name of Gallows Close. Bowling at no time formed part of the manor of Bradford, though it became merged in the Lacy

fee, but the field in question lay just within the boundary of the manor of Bradford. Towards the end of this (thirteenth) century the town had attained a high degree of prosperity, as every record proves. In 1295 the Thursday market was confirmed by charter ; likewise there was granted the liberty to hold a five days' fair, to commence on the eve of the "Feast of the blessed St. Peter in chains" (July 31st), but in subsequent grants the time for holding the fairs was changed to suit the greater convenience of the inhabitants. In this year (1295) the tolls of the market and fair, with the rent of the water mill, yielded the handsome return of £17 6s. 8d. Through the beneficent legislation of Edward I., Bradford in common with the rest of the country made very great advances. Measures were constantly being taken to ease the shackles of feudalism and extend the liberties of the people, and by his wise and popular government the King lived to see the country in such a condition of happiness and prosperity as it had never before witnessed, nor did again for fully two centuries afterwards.

Strong as was the contrast between the opening and closing years of the fourteenth century to the people of Bradford, one thing must be cited in extenuation of the bitter reverses of that period—namely, the overthrow of the old feudal power, and the beginning of that civil and industrial freedom which is the "flower and strength" of a nation's progress. Had the administrative ability of Edward I. been continued in his successors, Bradford would not have presented the sorry spectacle it did during the greater part of this century. At the commencement it was one of the most valuable of the Lacy possessions ; at the end it had sunk to the condition of a struggling village, reduced in population, wealth, and energy. The famous inquiry held in 1311, on the death of Henry, Earl of Lincoln, gives us an excellent idea of the flourishing condition of Bradford at this time. Though gift and alienation and subinfeudation had done

not a little to reduce the manorial largess, yet the creation of new freeholds, with the increased population and advance in the value of every kind of property, made ample amends; and we are, consequently, left with a pleasantly-instructive picture of the extent and aspects of Bradford in the early part of the fourteenth century. The manor was now far from being co-equal with the parish, a fact which, it may be observed, has led some writers astray. As this and other subsequent records relate to the *manor* of Bradford and not to the *parish*, we must be careful to distinguish between the two, for whereas the parish embraced the mesne manors, the manorial title only covered those properties in possession of the lords at the time of the inquisitions. In 1311 there were within the manor 30 burgage or town-houses, with their appurtenances, for which the united burgesses paid £1 17s. 6d. yearly. It would thus appear that Bradford had now acquired some reputation as a trade-town, while the purely agricultural occupiers had probably, under the lenient policy of the Lacies, greatly extended their holdings; the demesne lands being computed at the moderate area of 40 acres, demised at 8d. an acre to divers tenants at will. But there were in addition 156 acres that had been taken in from the waste, which were likewise let to various tenants at will, at 4d. an acre. No doubt more attention was being paid in the district to the growth of wool, which greatly to the detriment of home industries was being largely exported abroad, and it was not until some forty years after the date of this inquisition that Edward III. forbade under penalty of "life and limb" any exportation whatever of English wool. That the manufacture of cloth had already obtained a footing in the district is apparent from the item of £1 received in 1311 from the Bradford fulling-mill. But the corn-mill, with its continuously augmenting soke rights, was a much more valuable acquisition at this time, yielding annually £10 to the lord, or fully one-fourth the income of the whole manor. Could the profits of these old soke-mills be presented in

periodical returns, they would afford an interesting index of the fluctuating fortunes of the town from early times. In 1342 they had declined to £6 6s. 8d. annually. In 1770 they were let for £166 a year; in 1814 they let for £800, and in 1836 for £1250 per annum. One might have concluded that the profits of the weekly market and annual fairs would have yielded more than £6 in 1311—the market £3 and the fairs £3; but there were other important rival markets within a few miles of Bradford. Skipton, for example, yielded at this time £16 13s. 4d. from the tolls of its weekly market and annual fairs, while the tolls of the country fair at Embsay, established by the Canons of Bolton Priory, were even worth £8 10s. a year. We sometimes find mention made of a "castle" at Bradford, though no evidence is forthcoming that any castle existed. In 1311 the Earl's capital mansion at Bradford is described as a "hall with chambers," while that at Clitheroe in his fief the same year is designated a "castle," thereby marking a distinction. But the hall at Bradford was no mean place, and possibly had a tower attached. It is definitively stated to have been walled of stone and to have had chambers, at a time when many of the mansions of the great landowners and even on the royal demesnes had no upper rooms, but were simple stone or post-and-pan buildings of one storey, with their roofs open to the thatch. The burgage houses in Bradford were possibly also of stone, as much stone seems to have been quarried in the neighbourhood of Ivegate in the early part of this century. But most of the houses were doubtless at this time mere huts or sheds, chiefly of wood, with the well-trodden earth their only floor. What is now understood by sanitation was then unknown, for the streets were simply open ashpits, rank with filth, whilst nearly every house had a pig-sty. Although Edward I. had encouraged the use of domestic baths, and they had long been used in the monasteries, there is not a suggestion of their adoption in Bradford till 1438, when one Thomas Rawson obtained

leave to erect a bath or washhouse on his premises near the beck in Godmanhode. It was the duty of every householder to keep the road in front of his own premises free of all obstruction, but little heed seems to have been taken of this. The public thoroughfares were constantly filled with refuse, which was only removed on special occasions—as when John of Gaunt or other great lords passed through the town on their hunting tours. Then, no doubt, there would be a hurry scurry, the pigs and dogs would be driven inside, and the roads, laid with fresh soil, would be made fairly passable. The purity of the water of the town beck seems wisely enough to have been rigidly looked after, but despite such oversight it did not always escape contamination. In 1357 a Bradford tanner was charged with emptying the sweepings of his tan-house into the road, and with flooding the beck so that it overflowed the road, which became impassable. This was no doubt a very bad case, and one about which the inhabitants had a right to complain, as the beck water was a public daily necessity.

The Battle of Bannockburn in 1314 completely turned the tide of progress throughout the north of England. The case of Bradford was particularly bad. Its great owner, the Earl of Lincoln, had been Protector of England during the King's absence in Scotland, and when the crash came the Scots seem to have fallen with more than ordinary fury on this part of the country. They came down Airedale from Skipton, destroying and pillaging where they could, all resistance being useless. The monks of Bolton, who had lent men and wains for the conveyance of the English King's baggage, &c., into Scotland, had to leave their abbey to the assaults of the marauders, and shut themselves up in Skipton Castle. Churches and houses, farm and field, were everywhere wrecked and plundered, and for many years it was useless sowing corn. The church at Bradford would appear to have been so far damaged

that a new building, or very extensive repairs, had eventually to be decided upon, and the eastern-most columns of the nave point to a reconstruction about this time. The vicarial tithes had fallen to nearly one-third of their normal value, and other parishes in the neighbourhood had a similar tale of poverty and distress to relate. Rents everywhere declined, and notwithstanding the creation of new tenancies, the manor continued to yield a lower rental down even to the time of Henry VIII., than it did at the end of the thirteenth century. On the death of the Earl of Lincoln in 1310, the manor remained in dowry to his widow, but the advowson of the church fell to Thomas, Earl of Lancaster, who had married the earl's daughter and heiress. He would have succeeded to the manor also, but his unfortunate downfall and subsequent execution at Pontefract in 1321 threw all his estates and hereditaments into the hands of the King. In 1327 the manor and advowson were granted to Henry Plantagenet, whose son and successor, Henry, Earl of Derby, was created Duke of Lancaster in 1351. There is a very interesting record of the "contents" of the manor in 1342, when the Earl succeeded to the property, the most striking feature of which is the disastrous fall in rents, and consequent diminished value of the lord's interest therein, brought about by the penury of the inhabitants through the Scottish reduction. Still the owners' wealth seemed unlimited, and in spite of such reverses, they lived in very great state, and spent money lavishly. At a time, for instance, when land in Bradford was let at 12d. an acre, or 4d. and 6d. an acre in bond-tenure, it is affirmed that Thomas, Earl of Lancaster, regularly expended £7000 per annum, the equivalent to near £100,000 of present money. Why they allowed their manor-hall in Bradford to remain in ruins, as it is recorded in 1342, is not very clear; probably it had been a Crown possession for some time before the grant was made. Three roods of land attached to the hall-estate were now

farmed by the Vicar of Bradford and Wm. Walker, of the fulling-mills, at a rent of 12d. each. The demesne still consisted of 40 acres, lying in the hall-field, which were let at a rack-rent of 12d. per acre. The 150 and odd acres mentioned in the last inquisition seem wholly to have relapsed into waste. Cloth still continued to be manufactured in the district, but the fulling-mill yielded now only 8s. annually, and it was sadly in need of repair. The church, however, would, as stated, appear to have been rebuilt and re-endowed, for the advowson is now returned at the annual value of £100. On the death of Henry, Duke of Lancaster, in 1361, the manor of Bradford descended to the famous John of Gaunt, who had married the late duke's daughter, and on his being advanced to the dignity of Duke of Lancaster, the manor became vested in the Crown, and as an appanage of the Duchy of Lancaster it continued till the reign of James I. While the great John of Gaunt was lord paramount of Bradford, an interesting horn-blowing custom is stated in Blount's *Singular Tenures* to have been originated by him in Bradford. But this is not correct. The records of the manor show that in 1342 a John de Northrop had been granted three messuages and six oxgangs of land in Manningham for the service of attending the lord into Blackburnshire with one lance and one dog, to hunt wild boars for the space of forty days, receiving yeoman's board 1d. for himself and ½d. for the dog. Another grant was made to a tenant in Horton, one Roger de Manningham, of a messuage and two bovates of land to be holden for a similar service, to appear yearly at Bradford at the Feast of St. Martin in winter. Estates in other parts of England were held at this time by a similar tenure, while the service of winding a horn when there was an invasion of the Scots was also incident to many manors. Among the conditions of Northrop's tenure is mentioned a payment of 8d. due annually in lieu of boon-labour at seed-time, which seems to have been cancelled

upon Northrop's engaging to provide a hunter's horn which he was to bear with him and sound on the lord's coming to Bradford and at other parts of the journey. A descendant of Northrop afterwards granted land in Horton to one Rushworth of Horton, to hold the hound while Northrop's man blew the horn. The occurrence of these visits must have been the great event of the year to Bradfordians at that time; tenants bond and free, and country yokels from many miles around, would flock into the town to see their wealthy and renowned chief, John of Gaunt, in shining silver armour (which he is said always to have worn), attended by a numerous body of retainers all mounted on richly-caparisoned horses, moving in grand procession up Kirkgate and westward out of the town. The site of the old horn-blow lands can still be identified at Manningham, and a portion of them continued in possession of the Northrop family for nearly five hundred years after the original grant in 1342. At this time the bulk of the tenants in Manningham belonged to the villein class, each of whom held a small portion of land by what is called "base tenure." This species of slavery did not bring with it any material discomforts or render their condition in any degree more burdensome than that of the freeholders or free-farmers of the manor. Contrasted with the free tenants, who paid higher rents, but beyond heriot-dues on succession were exempt from any other burthen, the status of the villeins (or copyholders as they became) was eventually, as feudal servitude declined, even better than theirs. The farms of the bond-tenants were held at a low rental, and they successfully resisted all attempts to advance the rents even as late as 1540, when boon-service had practically died out. A singularly interesting example of the varied services peculiar to a local holding in bondage is furnished in the case of one John Rienes, of Bradford, who in 1342 held a messuage and an oxgang of land, paying yearly 3s. 1½d., and 3d. for release of harvest work. He paid also for

depasturing his drove-beasts on the common under the name of "Thistle-take" 12d. yearly. Conjointly with other neighbour serfs he had to repair the mill dam, receiving for his pains part of a measure of oatmeal, and for providing the mill-stones he received the old mill-stones and half of the old timber for his labour. He was also granger or keeper of the mill, for which service he received nothing. He had also to furnish a man and horse to carry the lord's victuals on his journeys from Bradford to Blackburnshire, receiving at each town 4d. Likewise he had to join with other bondmen in carrying all wood required for the lord's works, receiving for every cart-load, or ten burdens, 12d. He was, moreover, forbidden to give his daughter in marriage, neither could he allow his son to receive the tonsure without licence. Such were the conditions by which a Bradford tenant in the fourteenth century held an estate in villeinage, and though most of these conditions lapsed by desuetude, yet the Manningham bondmen, it should be noted, held themselves responsible for the repair of the manor corn-mill down to the beginning of the sixteenth century. The above John Reines became one of the largest land-owners within the manor, and also lessee of the soke-mills, thus attaining a position of affluence, if not of dignity, and going a long way towards justifying the statement of a contemporary poet, Piers Plowman, that "bondmen' sons have been made bishops." The latter half of this century was eaten up with war and famine, aided by that grim monster the Black Death. The sickness first broke out in England in the summer of 1348, and showed itself in the form of a putrid eruption of black spots on the skin, due, it is said, to the consumption of rotten food, and to general debility brought on by the impoverished state of the country. The sickness carried off whole villages and hamlets, and in some places there were not people enough left to bury the dead. The very imperfect character of the Court rolls of the manor, which are cited in the *Bradford Antiquary*, render

it difficult to estimate the precise extent to which Bradford suffered by this calamity. From an enumeration of the tenants in 1342, it would appear that the population of the township was then not far short of 600, whilst the Poll Tax of 1378 records 26 married couples and 33 adults. Allowing four in a family under the age of 16, we arrive at an approximate total of 189 persons, and to this must be added, say one-third more for able-bodied men who had been called to serve in the wars, for clergy, aged, infirm, beggars and other licensed exempts, making a probable total of 250 persons. In spite of some natural increase of population between the years named, it is not too much to affirm that fully one-half the people of Bradford had succumbed to famine and sickness between 1342 and 1378. The town in the latter year had not a third of the population of such a place as Bingley, and was only equal to some of the rural hamlets in Craven—Flasby for instance, which had 29 married couples and 23 single taxpayers. This Poll Tax of 1378 is also interesting as furnishing us with the names, and to some extent with the callings, of the various tenants. In the above estimate of population it should also be borne in mind that Bradford was becoming more and more a trade centre; tillage was declining, and the "shepherd and his dog" were taking the place of ploughmen. As a market town, however, its importance was being maintained. Among the 26 householders there were no fewer than three licensed hostelries, showing that there must have been a large amount of traffic in the town at that time. Dyeing and fulling still constituted an important trade element, though very much crippled by the social reverses of the last half century. In early times it was the practice to confine various trades to certain families, and many of our early statutes relating to trade guilds show with what jealousy this was regarded. A statute passed in 1363 enacted that "two of every craft should be chosen to certify that none use other craft than the same which he has chosen." In Bradford the

Walker family, who were also tenants of the corn-mill, had the dyeing and fulling business wholly in their own hands; and more than this, they were even permitted to exercise their trade to the exclusion of every one else throughout the Duchy of Lancaster. "No foreign fuller," is the wording of their agreeement with the lord of the manor, "shall carry on the said trades, neither within the town of Bradford nor within the liberty of the Lord Duke of Lancaster, nor shall any person migrate or take away anything to carry on the same business, only the said Thomas Walker and his son, or their servants." Such a monopoly was sure to prove a public grievance and also a source of vexation to its proprietors, for as a matter of course there were frequent attempts made on the part of outsiders to contravene the monopoly, and the Walkers had many disputes with such people who had entered upon the business without leave or licence.

The great event of the 15th century was the martial contest between the rival Houses of York and Lancaster, and such interest as Bradford took therein was naturally, as part of the Duchy of Lancaster, on the side of the Red Rose. Our neighbour, Robert Bolling, lord of the manors of Bolling and Thornton, took up arms against Edward of York, and along with his son, Tristram Bolling, was in the great fight at Towton, near Tadcaster, in 1461. His estates were confiscated but were subsequently restored to him, and one of his sons, it may be added, became a Baron of the Exchequer. The parish church, which had been re-erected or greatly restored early in the reign of Edward III., was now almost wholly rebuilt. The eastern extremities of the north and south aisles were reserved as private chapels of the Leventhorpe and Bolling families respectively. From the will of one Jeffery Leaventhorpe, "of Bradforthdale," dated 1426, who orders his body "to be buried in the churchyard of the Blessed Peter the

Apostle of Bradford," and that of Vicar Rodes, dated 1435, who bequeaths 40s. "to the fabric of the new work of the Blessed Mary [the Bolling Chapel] in the church of Bradford," it would appear that the re-erection of the church had commenced some time between these two dates, and, as it was not completed until 1458, must have occupied nearly thirty years in building. The massive fortress-like tower, apparently commenced before the general body of the church, was not completed until the 23rd Henry VII. (1507). It is noteworthy that on the south front there is a shield of the Tempests, a bend (defaced) and six martlets.

The dissolution of religious houses would appear to have affected Bradford only in so far as it gave fresh zest to individual enterprise and to that spirit of self-support which had been steadily growing since the days of feudal decline. Outside the town a good deal of land had belonged to the monasteries, and its transfer to lay-ownership gave frequent opportunities to the freeholders and occupiers for obtaining favourable leases or of purchasing small lots, which was really the beginning of that sturdy independence and resentment of all personal servitude which continued ever afterwards to animate the public life of the neighbourhood. The severance of the manor of Bradford, in common with the rest of the Honour of Pontefract, from the Duchy of Lancaster, in the time of James I., added still more to individual liberty, and gave promise of a long era of prosperity, had it not been cut short by the disasters of the Civil War. There was a considerable improvement in the social and domestic life of the people, building operations greatly extended, and most of the houses of the local gentry were rebuilt in this and the succeeding reign.

Charles I. before 1630 had sold nearly the whole of the Crown lands to free his indebtedness to the city of London, and the manor of Bradford was conveyed by deed bearing

date September 9th, 1628, to four trustees of the city of London. These trustees subsequently sold the same to various parties, who by divers conveyances between 1640 and 1699 sold the manor to Henry Marsden, Esq., with whose descendants it remained till 1795, when it passed to the Rawsons. The manor and advowson of the church had generally descended together, but were separated on the grant of the church by Henry, Duke of Lancaster, in 1416, to the new-founded College of St. Mary's, Leicester, which was suppressed by Statute 1st Edward VI. Subsequently the advowson passed to the Maynard family, and in 1678 was in the possession of Mrs. Mary Buller, daughter and heir of Sir John Maynard, and widow of Francis Buller, Esq., of Shillingham, Cornwall, the same family it may be noted as that of the Right Hon. Sir Redvers H. Buller, Bart., K.G.M.G., the distinguished commander of the English forces in the Transvaal war. Mrs. Buller afterwards bequeathed the property to her second son, James Buller, gentleman, by whom it was left in the hands of trustees for the term of 500 years, commencing in 1707; and from these trustees it descended by purchase till about 1835, when the Rev. Chas. Simeon, vicar of Trinity Church, Cambridge, bought the advowson from Mr. Richard Fawcett, of Acacia, Apperley, and in Mr. Simeon's trustees it is still vested. Few towns in the kingdom suffered more severely than did Bradford from the consequences of this Iron Age of civil strife and disorder. Although the manor had been so lately Crown property, yet there was now little Royalist feeling among the "free and independent" clothiers of the neighbourhood, who sided with the Parliament almost to a man. There is no doubt that, apart from their strong anti-Catholic bias, the inhabitants had been much aggrieved by the action of the King in quartering a troop of militia in the town to quell, as he thought, a suspicion of disloyalty—an action which seems rather to have strengthened than to have diminished any such local feeling. Sir Thomas Fairfax

in his *Memoirs* says that "the first action we had was in Bradford," though as a matter of fact the rupture had begun at Hull, where the first shot was fired and the first blood was shed in May, 1642. In December of this year the King's troops approached Bradford, but in the attempt to take the town they were vigorously repulsed. The attack was renewed some weeks later, but the inhabitants were now more fully prepared, and old engravings show the church tower hung round with wool-packs. After an eight hours' fight the Royalists were forced to fall back on their trenches; but events changed when, after the battle of Atherton Moor, a few miles to the south of Bradford, the town fell into the hands of the Earl of Newcastle, July 2nd, 1643. Fairfax with his army escaped to Leeds, and the town was at the mercy of the Royalists. The houses were pillaged, goods removed, and everything of value carried off. The inhabitants suffered dire privation, and much sickness and suffering followed. The registers of the church show that while the number of burials in 1642 had been 185, they rose in 1643 to 493! In 1644 they numbered 149, and in 1645 there were seventy-four burials. In the last mentioned year it is said large numbers died of an epidemic, and were buried in Cliff Wood, a short way out of the town, where—within living recollection—many skeletons have been found.

Many years passed before the town recovered from the disasters of the war; indeed, its population and importance had been so much reduced, that during the interregnum it was not included, like Leeds and Halifax, in the list of those towns which had the privilege granted them of sending each one member to Parliament. King Wool, however, was active in bringing back to the town what despotic hands had taken away; and as some evidence of returning prosperity, the accounts of the parish show that in 1686 the large sum of £24 9s. 9½d. was raised in Bradford, on a brief sent out to the different parishes in aid of exiled

French Protestants. Bradfordians, after their own bitter experiences, could fully sympathise with their foreign brethren in distress, and no doubt a special effort was made to relieve them. Still the town was by no means the place that it had been before the war. In 1692-3, when the new method of taxation was introduced—the basis of our present land-tax—a rate of 4s. in the £ was levied on Bradford, in common with other places, for the purpose of carrying on a vigorous war with France. The assessment is interesting, as showing the relative rateable value of the different townships in the wapentake of Morley at this time, some of which may be named for comparison:

Sowerby, £360; Halifax, £350; Northowram, £337; Southowram, £206; Ovenden, £205; Bradford, £200; Horton, £109; Haworth, £105; Hipperholme and Brighouse, £117; Elland and Greetland, £153; Warley, £181; Pudsey, £107; Heckmondwike, £43.

Strong in their Protestantism, the inhabitants of Bradford had little sympathy with the Stuart rising, and in 1715 the parish accounts show the payment of 12s., made for ringing the church bells in token of rejoicing at the defeat at Preston. Again in 1745 the sum of 4s. is entered as having been paid on December 21st, by order, "when ye Regiment of Royal Scots came through the town": an item of interest which no doubt marks a step in the movements of the flying column despatched by Marshall Wade, to cut off the northward retreat of the rebels from Preston.

The whole current of events from this time points plainly to the fact that the great body of inhabitants was opposed to any interference with its political freedom, or to any form whatever of arbitrary government. For nearly six centuries they had experienced the monopoly of property and power by the sovereign and the nobility and clergy. The principles of a wider civil liberty were now beginning to be felt, which added new life to the popular

aspiration to help forward the cause of that constitutional freedom which makes a people happy and a nation great.*

3.—MODERN BRADFORD.

By A. R. BYLES.

Although it is the sixth city of the United Kingdom, Bradford at the first glance does not convey to the visitor the sense of dignity and importance which attaches to many towns of smaller population. Huddled together in a hollow and straggling up the sides of two hills, Bradford was even at the opening of the century scarcely more than an overgrown village with a growing trade in wool and manufactures thereof. It had never been of much account as a market town, for it was dwarfed by Wakefield, Halifax, and Leeds, all of which were more accessible by road and were commercially of higher standing. But, in the keenness with which its inhabitants followed the growing trade in worsted manufactures, Bradford was no whit behind the rest. Indeed, the history of Bradford from the middle of the eighteenth century until after it became a Parliamentary and municipal borough is practically a record of its industrial growth and nothing more. In the year 1773 the manufacturers found it to their interest to set apart a building exclusively for the sale of worsted goods. Hence the erection of the Piece Hall in Kirkgate, the fore-runner of the present Exchange. Hither, we are told, were brought great numbers of piece goods of various kinds besides worsted tops and gross yarn, which were exposed for sale every Thursday morning precisely at ten o'clock, as announced by the ringing of a bell, the closing of the

* In the preparation of the above paper, the author acknowledges his indebtedness to James' *History of Bradford*, Whitaker's *Loidis and Elmete*, and to those useful repositories of local history and archæology, the volumes of the *Bradford Antiquary*.

market being alike rung off at half-past three in the afternoon. Fines were imposed on any who ventured to open business before the appointed time. The writer of the historical sketch, which appeared in the Bradford Directory, thus describes the aspect of the town as it was then and how it began to prosper :—

"Nearly every house had its garden, and the fields and woods around the town were fresh and verdant. The Manor Hall was the chief building at that time, having been built in 1705, on the site of an old hall, by Mr. William Rawson, an ancestor of the late Miss Rawson, lady of the manor of Bradford. The Paper Hall and a few other old mansions stood in various parts of the town, and there were inns which did a flourishing business, the Talbot, the White Lion, the Bull's Head, the Bowling Green, and the Pack Horse being amongst the number. Kirkgate, Westgate, and Ivegate were the three streets which comprised the main portion of the town ; from this centre, lanes branched off in various directions, and houses were to be seen scattered here and there with an utter disregard of building laws, and often too of sanitary requirements. The beck—clear and fresh, and with trout sporting in its waters—was a noticeable feature of the landscape, and the bridge at the bottom of Ivegate, and the other at the foot of Kirkgate, formed pleasant lounging places for the gossips and idlers. The market was at the bottom of Westgate, where an ancient stone cross stood in the middle of the street. Except the Parish Church and the Grammar School (which at that time stood near the church) there were but few institutions for the spiritual and educational advancement of the people. The Presbyterians had a place of worship in Chapel Lane, and the Quakers a meeting-house in Goodman's End. In 1755, the Wesleyans rented a large room in the cock-pit, and worshipped there for some time ; and in 1766, the Octagon Chapel in Great Horton Road was built. The prosperity of the town was much enhanced by the making of the Leeds

and Liverpool Canal, with a connecting branch to Bradford, which latter was completed in 1776. Not long after the completion of the canal, the Bowling Iron Company was constituted for the purpose of bringing into use the mineral ores underlying that productive district. In 1788—the year preceding the formation of the Bowling Iron Company—other iron works were established at Lowmoor, and in 1810 the Bierley ironworks (which at a later period were purchased by the Lowmoor Company) were founded. About the same time a Bradford manufacturer—Mr. Buckley—conceived the idea of introducing steam power into a Bradford worsted factory. He accordingly purchased a plot of land in Manchester Road, and was about to proceed to the erection of the proposed mill, when a number of influential inhabitants (including some who afterwards were prominent proprietors of worsted mills) met together and subscribed their names to a notice, threatening this worthy pioneer with all the terrors of the law should he 'presume to erect or build any steam engine for the manufacture of cotton or wool' in the place named, if the same should be found a 'nuisance.' Mr. Buckley had not the courage to face such powerful opposition, so he gave up his project and removed to Todmorden. In 1794 Mr. James Garnett, the founder of the present firm of Garnett & Co., erected a couple of spinning machines in the old mansion called the Paper Hall, in High Street. Soon afterwards Mr. Robert Ramsbottom, who occupied a house in Kirkgate, worked on his premises several spinning machines by means of a gin horse, and about the same time introduced the first combing machine into Bradford, which was so far from being a success that the owner is said to have taken off his hat to it and wished it a long farewell as it was carted from his yard. Five years after Mr. Buckley's ineffectual endeavour to start a steam-factory in Bradford, a more successful attempt was made by Messrs. Ramsbotham, Swaine & Murgatroyd, who in 1798 proceeded to erect a mill in the Holme. The

inhabitants still looked with disfavour upon these projects, and would fain have prevented them from being carried forward. The mill, however, was completed in 1800. It had an engine of 15-horse power. The way having been thus paved, other mills were speedily erected. In 1801, Mr. Richard Fawcett built one; in 1802 another was erected by Messrs. Benjamin and Matthew Thompson; and in 1803 one was built by Mr. John Rand. As yet it was only spinning machinery that was worked by steam; more than twenty years elapsed before the introduction of power-looms into the worsted trade. In 1800 the average number of pieces exposed for sale in the Bradford Piece Hall was about 3000. A few years afterwards the number was trebled. Mills continued to multiply, and the population increased at an enormous rate. In 1810 there were five mills in the town of an aggregate horse-power of about 250: in 1820 twenty mills of about 538 horse-power; and in 1833 thirty-four mills, of 1148 horse-power. In 1824 the woolcombers within a radius of six miles round Bradford numbered about 6000, and in 1825 there were from 7000 to 8000; and the weavers were estimated at three times the number of the combers. In 1822, Mr. James Warbrick, a Bradford manufacturer, had had a power-loom secretly made, and had erected it and put it in motion in a mill at Shipley. The news oozed out, however, and a mob of weavers surrounded the mill and threatened the building with destruction unless the loom were instantly removed. Mr. Warbrick was thus compelled to take the loom down. He had it placed in a cart, under an escort of constables, but as the loom was being conveyed away the excited weavers made an attack upon the party, routed the constables, destroyed the loom, and dragged the roller and warp in triumph through Baildon. Shortly afterwards, Messrs. Horsfall set up some power-looms in their mill, in North Wing, and in May, 1826, their factory was the scene of a serious riot, resulting in two persons being killed and a large number wounded. After

this unfortunate affair, the Bradford manufacturers were permitted to carry on their experiments without molestation, and the adoption of machinery became general, improvement succeeded improvement, and the demand for stuff goods grew with the extension of the capacity for production."

All this material growth involved the dislocation of the old industrial relationships, and was accompanied by the commercial crises following upon the Napoleonic Wars. Strikes, riots, periods of intense depression, produced great poverty and distress among a population which was growing at a terrible rate. Pauperism and crime seemed to grow faster than wealth. In the first fifty years of this century the population increased sevenfold, and yet such was the state of local government that the town was allowed to grow, like Topsy, pretty much as it might, and without the slightest attempt at regulation or plan. The old and important thoroughfares were narrow and tortuous, and new streets, as they were made, were scarcely better as regards width; and their laying out had no regard to the general public convenience. A body of Lighting and Watching Commissioners, instituted by the Act of 1803, did little more than look after vagabonds, pass resolutions threatening the owners of vagrant pigs, and quarrel about the number of nights in the month that the public oil lamps should be lighted. In 1843 a Board of Highway Surveyors was constituted. Their powers were very limited, and there was frequent conflict with the older body of Commissioners, but they were at least men of public spirit and did something to bring order out of the insanitary chaos which prevailed.

Bradford has, however, been made what it is to-day by the men who have served on its Town Council since the incorporation of the borough in 1847. Here and there, as in the upper part of Kirkgate, in Ivegate, and in Westgate, it is still possible to define one side of the old street line by the few old buildings that remain, but

practically the whole of the streets and buildings in the centre of the city belong to the period of the last forty years, and in the transformation nearly all the old landmarks have been obliterated. A good deal more than a million and a half sterling has been spent upon street improvements alone since the advent of municipal government as we now enjoy it, and by far the greater part of this sum has been expended upon a comparatively small central area. If the work were to be done over again in the light of our present experience it would no doubt be better done and the plan of the city would be materially improved. One illustration will suffice. The Bradford Exchange was about to be built in 1863, and the Corporation decided that the street should be widened, but there was hot debate in the Town Council as to whether the new width should be 14 yards or 16 yards. The more generous limit was adopted, but this is now the narrowest part of the street and if the question had to be settled afresh, Market street, the principal thoroughfare of the city, would probably be made 30 yards wide. Still, on the whole, the city fathers have indeed done wonders under most adverse conditions, not the least serious of which has been the enormously enhanced value of land brought about by the very drastic character of their own improvements.

The rebuilding of the town is, however, but one of the manifold directions in which energies of the municipal machine have been expended. Up to 1861 the town was without any adequate or efficient system of drainage. The "becks" (the natural watercourses) had been built over and their channels otherwise obstructed until whenever the town was visited by a heavy thunderstorm they were incapable of carrying away the storm waters and the sewers being very soon choked, the streets in the lower part of Bradford were frequently flooded. Nearly £300,000 has been sunk in the sewerage of the city, which is now practically immune from floods, notwithstanding the rapidity with which in time of heavy

rain, the surface water concentrates in the centre of the city. Water supply is a matter of the first importance in relation to health and domestic comfort of any community, but there is another reason why an ample supply of pure soft water is of vital importance to Bradford. The very existence of the trade depends upon it. In no other centre in the world is so much wool prepared for spinning and manufacturing, and the first process to which it is subjected is that of scouring or washing. Wool cannot be washed in hard water, and this fact has had an all important bearing in restricting the sources available for supplying the city. The peculiar configuration of the city, moreover, imposes upon the community an enormous engineering difficulty. The lowest part of the basin in which the city is mainly comprised is barely more than 200ft. above sea-level, there are parts on the edge of the basin within the area to be supplied which are 1200ft. above sea-level. In 1854 the Corporation took over at a cost of £192,000 the undertaking of the Bradford Waterworks Company, paying the shareholders—who had never seen any decent dividends—£40 for their £20 shares, and immediately set about extending and developing the system. It was then, and still is, a gravitation system, all the water being collected in drainage areas at high elevation and delivered in the town by conduits and pipes without resort to pumping. For distribution purposes the system is divided into two distinct systems of supply, the low and the high level, all areas below 475ft. above sea-level falling within the former category, and all above that contour line being served from the high level system. The catchwater areas are comprised within the Aire and Wharfe valleys, most of the low level supply coming from the moors above Barden on the Duke of Devonshire's estate in Wharfedale, while the high level reservoirs are on the high lands at the head of the river Worth, a tributary of the Aire, which it joins at Keighley. The otherwise obviously natural supply area in upper

Airedale is barred by reason of the hardness of the water due to the limestone foundation, and the same objection applies to the head waters of the Wharfe itself. This double obligation to seek water at a high level and to reject all hard water has rendered the construction of works both costly and difficult; so that, although from the time when the works were first municipalised in 1854 until the present day the Corporation has been almost without cessation engaged in works of extension, and has spent on the two systems close upon three millions sterling, the supply has never been much more than adequate to meet the ever-growing demand, and has not infrequently been very far short of doing this. Twelve years ago the necessity of taking steps to secure the inhabitants from future scarcity led the Corporation to consider a scheme projected by the present Chief Engineer of the London County Council (Sir Alexander Binnie), then the Waterworks Engineer of the borough.

On Mr. Binnie's removal to London, the Nidd project was taken in hand by Mr. James Watson, M. Inst. C.E., the present Waterworks Engineer, who designed an entirely new scheme, which received the sanction of Parliament in 1889. This has been carried almost to the completion of its first and main instalment by Mr. Watson. In its entirety it comprises three storage reservoirs at the head of the Nidd valley—Angram, Lodge and High Woodale —with an aggregate capacity of 2,596,000,000 gallons, a main conduit 33 miles in length with six miles of branches, the starting point being 933 feet above sea level, the necessary filter beds and service reservoirs at Bradford, and a vast compensation reservoir in the Nidd valley at Gowthwaite some thirteen miles below the point of intake of the Bradford supply. The Gowthwaite reservoir is now finished, and upon the completion of a tunnel four miles long under the high range which divides Nidderdale from Wharfedale, some time in the later part of next year (1901) Bradford will have a magnificent and

unstinted supply of soft water derived from a catchwater area, which may be described as absolutely uninhabited and uncultivated moorland. The cost of the Nidd works, with the necessary service reservoirs and filter beds up to the point when the supply from this source will become available, is estimated at £1,500,000, and by a comparatively small expenditure in future years upon storage reservoirs and duplicate pipe lines the capacity of the system can be greatly increased. At present the low level system is capable of providing a daily ration of eight million gallons and the high level system about four million gallons. The opening of the Nidd service will nearly double the total of the two.

In addition to the two engineering systems of drainage and water supply, the Corporation has undertaken much other specifically sanitary work. Public baths for both sexes and wash-houses were first established in 1865, and a large scheme for new central baths and for district baths is now being carried into effect. Two large cemeteries, Scholemoor and Bowling, have been provided; the Fever Hospital, originally founded as a charity, was taken over in 1887, and has since been more than doubled in accommodation (160 beds), and a Small-pox Hospital (50 beds) has recently been established at Bierley Hall, on the south side of the city. The cleansing of the ashpits, until 1898 carried out by contractors, was in that year taken over by the Health Committee, and is more efficiently performed at a cost of about £10,300 per annum. Refuse destructors have been constructed at four or five convenient centres, and the "tipping" of refuse has been entirely discontinued. Although no decided success has been achieved, much valuable experience has been attained by experimental works for sewage defœcation, upon which £150,000 has been expended during the past thirty years. The problem, which in the case of Bradford is complicated almost to the despair of chemist and bacteriologist alike, by the character of the manufacturing discharges, is now not only perfectly

understood, but is apparently in a fair way to successful and early solution. Up to 1866, cattle, horses, and pigs were at the half-yearly fairs exposed for sale in the public streets, and the weekly markets were held either in the open or in old buildings amidst most unwholesome and uninviting surroundings. In that year the manorial and market rights of the Lady of the Manor were leased to the Corporation for 999 years, at the annual rent of £5000. Public wholesale and retail markets, with railway sidings, have been erected, a fair-ground has been provided, private slaughter-houses have been closed, and two well-equipped public abattoirs built at an outlay of £203,915, and they produce now in rents and tolls a yearly revenue of £23,000.

The sanitary condition of Bradford, and consequently the health of its population, has undergone great improvement during recent years. The Registrar-General, in referring to an outbreak of cholera at Knaresborough in 1849, said that "Bradford and other districts suffered more or less from the disease," and the reports of various committees of the Corporation show that diseases of an infectious order, particularly typhus fever, were widely prevalent for many years afterwards. In 1856 the death-rate varied in the different townships of the borough between 21 and 27 per 1000 inhabitants, a large proportion of the mortality being attributed to consumption and other preventible disorders. During many subsequent years the mortality was even higher. The continued attention subsequently given by members of the Corporation to necessary sanitary measures has produced an enormous change, with the result that the health of the citizens of Bradford to-day is vastly improved. During the past five years the death-rate has varied between 16 and 18 per 1000 of the population, a low rate for a manufacturing town. Such diseases as cholera, typhus, and smallpox are now almost unknown in Bradford. Many recently enacted Acts of Parliament have been adopted by the Corporation, *e.g.*, Infectious Diseases Notification Act

1889, Public Health Amendment Act 1890, which have undoubtedly prevented the spread of epidemic diseases and contributed to the generally improved health of the City. At the present time the Health Committee is devoting special attention to the abolition of certain insanitary areas and the better housing of the working classes.

In 1871 the Corporation purchased from a private company for £210,000, the gas works, and has since spent about twice that amount upon new works and extensions. The "make" of gas at the time of the purchase was 575 million cubic feet per annum, and the price was 3s., the quantity is now 1756 millions and the price 2s. 3d. per thousand feet. Net profits amounting in some years to £25,000 have been made on the working and have been applied in relief of rates, while the whole charge of the public lighting—a service which is estimated as costing £29,000 per annum—is borne by the gas department. Twelve years ago (1888) the Gas Committee of the City Council erected a small electric lighting station, and the business of purveying electricity for lighting and power soon became so profitable that new works and extensions have already absorbed £217,000, and the annual revenue is increasing by "leaps and bounds." Eight public Parks and nine smaller Recreation Grounds, comprising an aggregate area of 306 acres, provide breathing spaces for the people. A Free Library with 108,129 volumes (21,931 Lending, 42,500 Reference) with 10 branches (43,698 vols.) is dependent entirely upon the income from a penny rate (about £5175 per annum) for its maintenance. On the Queen's last birthday (May 24th, 1900) Lord Masham laid the foundation stone of the Cartwright Memorial Hall, which is to be a permanent art gallery and museum, nearly the whole cost of which (£55,000) is to be contributed by his Lordship as a gift to the municipality.

The policing of the city is efficiently performed by a force of 354 officers and men, at the annual cost of

£34,000, half of the cost of pay and clothing being borne by the Imperial Treasury. Life and property are guarded from fire losses by a well-equipped Corporation Fire Brigade, the total strength of which consists of 33 men and 13 horses, the annual charge being £5400. A new Central Fire Brigade Station, modelled upon the latest American designs, is now in course of erection.

The hilly character of all the main thoroughfares, with but two exceptions, delayed the introduction of tramways until 1880, when the Corporation laid down several lines and leased them. On one route only was horse traction possible, the others have been worked with steam locomotives. Two years ago two new routes were laid down, equipped for electric traction on the trolley wire system, and have since been worked by the Corporation with such signal financial success that powers have been acquired for seventeen miles of new lines. As the original leases fall in, the old lines will be similarly equipped and worked. Other municipally owned or operated institutions are the Technical College (see Educational Institutions), the Semon Convalescent Home, Ilkley, the Nutter Orphanage, and the Conditioning House. The Semon Home, built and endowed with £3500 by a former Mayor, Mr. Charles Semon, will accommodate seventy-five convalescents. The orphanage, which provides for forty boys, is the outcome of a bequest of £10,000 as an endowment by Mr. Joseph Nutter, who began life as a poor orphan in Bradford. For a description of the Conditioning House readers are referred to the article upon Commercial Institutions.

The municipal area of Bradford has been extended by various local Acts of Parliament, the last of these extensions having come into effect at the November election in 1899. As now constituted the area of the city comprises 22,843 acres, and it is divided into twenty-one wards, each represented by one alderman and three councillors. The present Mayor (Mr. W. C. Lupton) was elected from without the

Council. The following are the chief Corporation officers:—Town Clerk, Mr. Frederick Stevens; Waterworks Engineer, Mr. James Watson; City Surveyor, Mr. John Henry Cox; City Treasurer, Mr. G. A. Thorpe; Medical Officer of Health, Dr. W. Arnold Evans.

For administration of the Poor Law the city is divided. On the passing of the Act of 1837 a poor law union was constituted which was very soon found to be of unworkable extent, and in 1848 the four townships of Bradford, Bowling, Horton, and Manningham, which at that time constituted the municipal borough, were constituted a separate Bradford Union, the outside townships, sixteen in number, being constituted the North Bierley Union. From time to time as the borough was extended for municipal purposes parts of the North Bierley Union have been brought within the Bradford Union; but the extension of the City in 1898 has not yet been completed in this respect, and the townships of Tong, Idle, Eccleshill, North Bierley, and Thornton, though within the city boundaries, are still comprised within the North Bierley Union. The Bradford Board of Guardians consists of twenty-one elected members, seven who are returned for each of the three Parliamentary divisions, and two co-optative members. The workhouse, the foundation stone of which was laid in 1850 by Mr. W. E. Forster, the then chairman of the Board, has been frequently enlarged and improved, and a scheme for the erection of a new infirmary is now under consideration. About 840 paupers live in the house, and about 2000 out-door cases are relieved annually. The children, except infants, are all provided for outside the workhouse, forty in a central home, fifty in six cottage homes, and about eighty are "boarded out" in country villages. The pauper lunatics (432) are domiciled at Menston West Riding Asylum.

The North Bierley Union comprises sixteen parishes or townships with a total area of 30,545 acres, which form a ring round the centre of Bradford. All the townships most

recently added to the municipal area of Bradford are within the North Bierley poor-law union. The population of the union is 122,743 (estimated 1900) and the assessable value of property £474,305. The Board of Guardians consists of 35 elected representatives and one co-optative member; the number of paupers in the workhouse is 261, pauper lunatics at Menston, &c., 233, outdoor paupers 1608. There are very few children in the workhouse. The Guardians experience no difficulty in boarding them out with foster-parents or in finding homes for them as apprentices or hired servants.

The position of Bradford in regard to pauperism, population, &c., as compared with other large Yorkshire poor-law unions, is exhibited in the subjoined table. For purposes of comparison the Bramley, Holbeck, and Hunslet unions should be grouped with Leeds, and North Bierley should be similarly grouped with Bradford:—

	Population, 1891.	Assessable Value, 1899. £	Percentage of Pauperism on Population.	Expenditure on Relief, 1899. £	Rate in the £, 1899, for Relief, d.
Hull	135,681	624,801	2·8	25,419	10·5
Dewsbury	162,596	612,740	1·4	12,952	5·1
Bramley	67,398	254,345	1·9	6,807	6·4
Holbeck	25,573	106,280	2·3	3,133	7·1
Hunslet	70,920	262,736	1·7	8,557	8·1
Leeds	223,154	1,096,572	2·2	29,663	6·5
Halifax	185,272	772,177	1·5	18,737	5·8
Sheffield	204,677	873,195	2·0	30,818	8·5
Bradford	202,975	1,187,620	1·3	20,887	4·2
North Bierley	138,906	468,814	1·4	12,499	6·4

For Parliamentary purposes the borough of Bradford—which is the area comprised within the municipal borough as it existed at the passing of the Redistribution Act of 1885—is divided into the Central, East, and West Divisions, each returning one member. The recently absorbed townships of North Bierley, Eccleshill, and Idle are comprised within the Shipley Division, the township of Tong is within the Pudsey Division, and the township of Thornton is within the Keighley Division, so that the citizens of Bradford as Parliamentary electors have six representatives.

APPENDIX TO HISTORICAL SECTION.

I.—THE BRADFORD DIALECT.

By ELIZABETH M. WRIGHT.

The area of Yorkshire is so great that it includes a large number of groups of dialects. The dialect of Bradford may be said to belong to the Eastern North Midland group, which embraces the whole of South Yorkshire. Many old words are to be found, and words showing that regular sound laws have been uniformly carried out, where, in the literary language, irregularities and anomalies have arisen—as, for example, in "māt" (Lat. mūtāre) to moult; "sarvent" and "rām," besides the irregular pronunciations "servant" and "room;" "sniu" (vb.), besides "snow" (vb.), which is a new formation from the noun; "antm" besides "anthem," which is a learned spelling. Such words as "laylock" and "obleege" show the old pronunciation which was only given up in literary English within the last century. The above are only a few out of hundreds of similar cases.

Then again, many words which have fallen together in sound in modern literary English are still kept apart in the Bradford dialect, e.g.: "yād" (yard), "yiəd" (yard—three feet); "wāk" (work), "wək" (to work), "meil" (meal, flour), "miel" (meal, repast), and many others.

Passing on to syntax, minute distinctions may be observed in the use of pronouns and in verbal forms, which are no longer kept up in the standard language. Take for example the personal pronoun "I":—

Singular	Plural
Nom., ai, a, i	wī, wi, wə
Obj., mī, mə	uz, əz, s.

The different forms are used according to the position of the pronoun in the sentence, and similarly with the pronouns for the second and third persons. With regard to verbs, the plural of the present indicative has no inflection where a simple pronoun immediately precedes, but in other cases it takes an s, e.g.: "*We din*," but "*Us at's done so mitch.*"

But the real interest of a dialect is in the words themselves. Of these numbers are here preserved, which have been lost in the literary language, because they are names of things not generally treated of in literature. Among them, names of household utensils, different kinds of food, agricultural implements, and trade words.

It is curious to note, however, that in some cases dialect has borrowed from the literary language. As examples of this may be quoted: "To play Hamlet," "To read the Riot Act," "Bastail" (workhouse), which is the French "Bastile"; "Demock" (potato disease), which is a corruption of "epidemic"; "tans," a corruption of "allowance."

For further details under this head reference may be made to the "Grammar of the Dialect of Windhill," by Joseph Wright, M.A., Ph.D., D.C.L., which is practically a grammar of the Bradford dialect.

2.—LOCAL PLACE-NAMES.

By BUTLER WOOD.

The most common place-name suffixes in the neighbourhood of Bradford are *ton* and *ley*. Within and around the city are to be found Allerton, Bolton, Clayton, Girlington, Heaton, Horton, Thornton, Drighlington, and Adwalton. These are all situated on high ground, but the *leys*, with one or two exceptions, are located in the lower parts of the valleys. The course of the river Aire from Skipton to

Leeds is plentifully strewn with place-names having this termination: i.e., Cononley, Bradley, Utley, Keighley, Morley, Bingley, Cottingley, Shipley, Thackley, Apperley, Calverley, Rodley, Farsley, Stanningley, etc. This termination disappears from the valley above Skipton, where, from the nature of the country, no clearings would be necessary. Many smaller places in this locality bear the suffixes of *shaw*, *shay*, *wick*, *wike*, and *royd*: e.g., Buttershaw, Birkenshaw, Oakenshaw, Toftshaw, Boldshay, Myra Shay, Shay House, Heckmondwike, Wike, Eldwick, Kildwick, Brownroyd, Heaton Royd, and Royd's Hall. The suffix *worth* occurs in Haworth, Oakworth, Cullingworth, Hainworth, Hawksworth, Hunsworth, and Rishworth. With one exception these are on high ground. *Crofts* are not so numerous as those just referred to, and places so named are usually isolated farmsteads, or small hamlets. Rycroft is probably the commonest form.

There is another group of place-name suffixes which is worthy of note, namely *By*, *Thorpe*, *Thwaite*, and *Gill*. *By* is present in Gaisby and Sowerby; *Thorpe* in Laythorpe, Priesthorpe, Gawthorpe, Leventhorpe, and Thorpe, near Idle. The suffix *Thwaite* appears in Micklethwaite, Braithwaite, Brunthwaite, and Thwaites: and *Gill* in Holden Gill, Snaygill, Raygill, and Agill. It may be remarked that the terminations *Ton*, *Ley*, and *Tarn* are not only evenly distributed over the immediate neighbourhood, but also over the whole of Yorkshire, but *By* and *Thorpe* lie, with a few exceptions, to the east of a line drawn north and south through Bingley. On the other hand, words like *Thwaites*, *Gill*, *Tarn* and *Fell* lie to the west of this line. The names of the natural features of the country vary somewhat from the ordinary English terms. Streams are called *Becks*. The word "hill" is in common use, but a few hills bear the suffix *Don*, as: Baildon, Rawdon, Yeadon. The low-lying lands are often called *Ings* or *Carrs*.

The street names of the city call for little comment, as most of them are of recent origin. During the progress of the scheme for improving the streets of the city, many of the old thoroughfares have been swept away, while others which remain have been considerably altered to meet modern requirements. The oldest existing streets are Kirkgate, Westgate, Ivegate, High Street, Vicar Lane, and Tyrell Street. Tong Street, which forms a portion of the road from Bradford to Wakefield, is said to run along the site of a Roman road, but there is no evidence to show that such a road ever existed.

II.—INDUSTRIES.

1.—INTRODUCTION.

By A. R. BYLES.

The foundation of Bradford is wool. It has grown out of wool as Manchester grew out of cotton and Middlesbrough has grown out of iron. In Bradford are centralised all the industrial and commercial activities of wool and wool products in Great Britain. Probably five-sixths at least of all the wool manufactured or partly manufactured in this country is at some stage the subject of a bargain in the Bradford Exchange or in some Bradford merchant's warehouse. Precisely how and why Bradford should have attained to this pre-eminence is almost an industrial paradox, and would fittingly form the subject of a most interesting study. Geographically everything would seem to have been against it. With strange perversity the town was built "in a hole," three miles away from the river Aire, whose spacious and lovely valley would seem to have afforded many more eligible sites. There is only one road out of the town, and that quite unimportant, which does not run up hill; not a single one of the old highways passes through it, and so generally inaccessible is it that to the present day, in railway phrase, it is "on a siding." Just half-way between the German and Atlantic oceans, tucked in under the great Pennine range, whose hills hold the clouds in almost perpetual embrace, there is no English town that enjoys so little sunshine. In the sixteenth and seventeenth centuries the whole district was more or less unknown, and was avoided by travellers as a dark, dismal, and "uncanny" land. And yet within this

comparatively small section of the West Riding (not more than 30 miles from north to south and about the same from east to west) is comprised practically the whole of the worsted and woollen industries of Great Britain. Of this small section Bradford is the geographical as it is also the commercial centre. In Wilts and Devon, at Leicester, at Kidderminster, and in the lowlands of Scotland there are woollen factories, but these may be regarded as sporadic or only the survivors of an industrial greatness long since past.

Originally, of course, the spinning and weaving of wool were purely domestic avocations, but so long ago as the 12th century, under the fostering care of the early guilds, the art of weaving cloth had become a special craft conducted for purposes of commerce and gain. These guilds flourished in London, Lincoln, Oxford, and York—in no one of which cities is a yard of cloth made to-day. England was at that time the only great wool producing country of Europe, and large quantities of the raw material were exported to Flanders,* where the cloth manufacture flourished exceedingly. All the terrors of the most stringent protective laws did not suffice to prevent smuggling or preserve even the home market to the English cloth weavers. To Edward III. it occurred that there was a more excellent way. He invited and encouraged Flemish weavers to settle in his kingdom with the immediate effect of a great technical advance in textile manufactures, and the rapid development of an export trade in woven fabrics. Norwich and a few places in Norfolk and Suffolk—the little village of Worstead among the number—became the chief seats of woollen manufacture, which, however, spread to Wiltshire, Somerset, Devon, and other counties of the south and west. It is singular that Bradford, destined to become the chief

* Taxes for King Edward III. were calculated not in money but in sacks of wool. Early in the fifteenth century £30,000 out of the £40,000 revenue from customs and taxes came from wool alone.—*Industrial History of England.*—Gibbins.

centre of the manufacture, should be the first place in Yorkshire in which traces of it should be found, but towards the middle of the sixteenth century, with the decay of the old city guilds, cloth making as an industry had taken firm root among the villages of the county of broad acres. Although the weaving was all done in the home, capital and labour were even then in evidence as distinct though not independent factors, as the following extract from an admirable paper, contributed in 1852 by Mr. Henry Forbes to the Society of Arts, testifies :—

"The work was entirely domestic, and its different branches widely scattered over the country. First, the manufacturer had to travel on horseback to purchase his raw material amongst the farmers, or at the great fairs held in those old towns that had formerly been the exclusive markets of wool. The wool received was handed over to the sorters, who rigorously applied their gauge of required length of staple, and mercilessly chopped up by the shears or hatchet what did not reach their standard, as wool fit only for the clothing trade. The long wool then passed into the hands of the combers : and having been brought back by them in the combed state (technically called 'top'), was again carefully packed, and strapped on the back of the sturdy horse, to be taken into the country to be spun. For this end the manufacturer had not only to visit the villages in the immediate neighbourhood of Halifax, Bradford, &c., but used periodically to traverse the romantic hills and dales of Craven. Here at each village he had his agents, who received the wool, distributed it amongst the peasantry, and received it back as yarn. The machine employed was still the old one-thread wheel ; and in summer weather, on many a village green or hill side, housewives might be seen plying their busy trade, and furnishing to the poet the vision of 'Contentment spinning at the cottage door.' Returning with his yarn, the manufacturer had now to seek out his weavers, who ultimately

delivered to him his camlets, serges, tammies, or calimancoes ready for sale to the merchant or delivery to the dyer." But the master and his family themselves worked as hard as any of those who worked for them, and lived quite as frugally. Wages were very small during the whole of the latter half of the eighteenth century. In 1780 woolcombers earned 12s. for a full week's work; women spinners 2s. a week, and girls from 15d. to 18d. a week. A good man weaver would earn 7s. 6d. a week, but the general average was from 5s. to 6s. On the other hand, rent and food were at moderate rates, until war prices set in. The style of living, both of employers and employed, differed comparatively little; oatmeal porridge, oat (or haver) cake, home-brewed beer and home-fed bacon, with plenty of milk, constituting the staple articles of food upon the tables of both classes.

In this early growth of the wool manufacture in the West Riding, no doubt—apart from the hard, thrifty, strenuous, and remarkably independent characteristics of the race—a most important influence was the abundance of soft water provided by the innumerable small streams or "becks" coming down from the heather-clad moorlands. In the washing or "scouring" of wool, which is the first operation in the long series of processes to which it is subjected before it becomes a perfected fabric, the softness or purity of the water is a vital matter. It was, however, the invention of machinery and the consequent introduction of the factory system which finally determined the supremacy of the West Riding in wool textiles. Here, again, the ample water-power afforded by the self-same becks, and, in later years, the proximity of abundant coal, conspired to ensure the progress of the district. The story of how, under the influence of steam and mechanics, four or five hundred square miles of hilly and inhospitable country, with a population mainly scattered in small villages, and with not a single town containing 30,000 inhabitants, has

been converted into one vast manufacturing hive, in which city verges on city, and one village merges into another, so that a person travelling by night from Kildwick on the north to Holmfirth on the south would never be out of sight of the gas-lamps, with a population increased more than ten-fold in numbers and a hundred-fold in real wealth and comfort of life—this is all the story of the present century. The romance of it belongs to the first half and must be sought for in "Shirley," in the history of the Luddites and Chartists, and in the more prosaic files of old newspapers. Measured by statistics the progress has been mainly in the last half of the century. The spinning jenny, the mule, and the power loom, as inventions, belong, indeed, to the later years of the eighteenth century, but they were first adapted to cotton, a much more docile material than wool, and the worsted trade was quite a generation later in taking any practical interest in them. Indeed, in Yorkshire these machines were regarded as little more than ingenious toys, until, after the close of the Napoleonic Wars, the people set themselves in earnest to the pursuits of peace. It was, however, the abolition of the Corn Laws, giving to the people cheap bread and to the capitalist cheap labour, which was the condition indispensable to a transformation analogous to and as complete in its way as the change from the bareness of the woods in March to their full-foliaged glory in June. Thus it comes that the names of Hargreaves, Arkwright, Crompton, and Cartwright are usually associated with the development of the cotton industry in Lancashire rather than with the much older and originally vastly more important textile—wool. But although, for the most part, the machinery used in the manipulation of wool is merely the adapted counterpart of that used on the other side of the dividing moorlands for the manufacture of cotton, there is one important exception — the wool-combing machine. Long after mills had been erected and great steam engines

were driving spinning-frames and power-looms by hundreds in many parts of this district, the wool continued to be combed by hand. Cartwright conceived and worked out the idea of a comb which was to be driven by power so far back as 1827, but wool is an intractable fibre, the nature and physical construction of which was but imperfectly understood at that time, and Cartwright's comb served only to suggest the way to others who came later. As to who shall ultimately have the credit of producing the first practical wool-combing machine, volumes of controversy of a bitter and personal character have been written. Two of the three claimants for the honour—Mr. E. Donnisthorpe and Sir Isaac Holden—are dead; one—Lord Masham, then Mr. S. C. Lister—is still in the enjoyment of a green and vigorous old age. It is sufficient here to state that all three had much to do with its evolution, and that Lord Masham has signalised his own indebtedness to Cartwright—doubtless also intending thereby to bid us look behind all the recent controversy—by devoting £50,000 to the erection of the Cartwright Memorial; the magnificent art gallery for the City of Bradford, now being built in Lister Park on the site of the old Lister home. One other name must, however, be mentioned in this connection, that of James Noble, the inventor a few years later of the revolving or great circle comb, the modern development of which, still known as the Noble comb, is now in universal use throughout this district. The introduction of combing machinery chimed in with Sir Robert Peel's great measure, and gave an immense impetus to the wool industry, which hitherto had lagged, mechanically at least, a quarter of a century behind the cotton trade of Lancashire. A never ceasing flow of minor inventions and improvements since then have vastly increased the quantity and quality of the productions of our spindles and looms, but no one of them calls for special mention here. Bradford as a manufacturing centre also owes not a little to the late Sir Titus Salt, who was

the first to bring into successful use the hair of the alpaca goat, and who thereby made Bradford dress fabrics and his own works at Saltaire alike famous all the world over. But the unique position which the city of Bradford holds as the greatest commercial centre of the wool trade is not alone due to its inventors or its great "captains of industry." In the early part of the century Halifax was of more importance as a worsted trade centre than Bradford. Huddersfield and Leeds were centres of distinct branches of the woollen trade. It was the advent, almost simultaneously, about fifty years ago of a few hard-headed and well-educated young Scotchmen, and of a number of keen and enterprising Germans from the free cities of Frankfort, Hamburg, and Lubeck which first lifted Bradford out of itself as merely one of a number of producing places. These gentlemen, settling here as merchants, founded on the one hand the "home trade" and on the other the export trade in stuff goods and woollens, and in later years, when hostile tariffs barred out the latter from many continental countries, the export yarn trade. Their efforts were ably seconded by the public spirit of its people, who, through their municipal authority, have completely changed the whole aspect of the town, and, through the Chamber of Commerce, have made the commercial reputation of Bradford stand as high as that of any city in the kingdom. Gradually but surely Bradford has become, therefore, not only the great manufacturing centre but also the distributive, commercial, and financial focus of the whole worsted and woollen industry of Great Britain. Its Exchange has 2300 subscribers, and the attendance on market days—Monday and Thursday—is only less than that of Manchester and, perhaps, the Stock Exchange in London.

Although Bradford is pre-eminently founded on wool, it also possesses the largest silk mill in the world. The silk industry is quite a modern development. Some five

and twenty or thirty years ago, Lord Masham, having made at least one fortune out of wool turned his attention to silk, and, by infinite pains, indomitable industry, and what threatened to be ruinous outlay in experiment, solved the problem of how to convert the gummy outer shell or wrapping of the silk cocoon into a valuable fibre, thereby laying broad the foundations of a collossal enterprise.

In subsequent sections of this chapter, the nature of the various processes of manufacture, the character and variety of the different products, and the extent and value of "the Bradford trade" are described as fully as the limited number of these pages will admit.

2.—THE STAPLE.

By A. R. BYLES.

In the first two centuries after the Norman conquest, many towns, growing in importance as trade centres, acquired privileges by charter confirming them in the monopoly of the manufacture or sale of certain products, the *staple* of the district, and these towns were hence called *staple towns*. This system of trade centralisation begun by the first two Edwards was firmly established by Edward III., who by statute (*) enacted that only merchants of a particular staple, such as wool or hides, might export those goods. Wool was in those days pre-eminently the most important and valuable of those staple commodities. A lock of wool taken from the fleece is still called a staple, wools are frequently classed as long or short stapled, and the Bradford merchant who attends the country wool-fairs, or who buys his clip from the grower himself on his own farm is still called a woolstapler. Fifty years ago

* 27 Edward III., c. 9 (1354).—Gibbins.

Bermondsey (where now stands the Midland Hotel), Cheapside and Piccadilly were entirely occupied by the warehouses of the woolstaplers, who at the time were not only a more numerous, but were relatively a much more important and perhaps substantial, body in Bradford, than they are to-day. Their place in the economy and the trade has been largely usurped by the foreign wool merchant (who is never called a "stapler") and the "top-maker." More home-grown wool comes into Bradford now than was the case then, but the quantity, large as it is, has become almost insignificant in comparison with the enormous weight of wool, mohair, and alpaca which is brought here every year from Australia, New Zealand, Cape Colony, South America, India, Turkey and other countries. A large proportion of the wool which comes to London from Australasia and South Africa is bought at the public sales there by French, German, and American users, and being re-exported, never comes further than the warehouses at the docks. Statistics of imports therefore, without reference to the re-exports are misleading, and in the following table such re-exports and the exports of home-grown wool in its "raw" state are excluded; but of the total "consumption," much, of course, is subsequently exported in the form of cloth or yarns, while not a little of that which is taken to France and Germany comes back to us in its manufactured state.

TABLE I.—Home-grown and Imported Wool consumed in the United Kingdom (including Alpaca, Mohair, &c.).

	Domestic Wools. Million lbs.	Foreign and Colonial Wools. Million lbs.	Total, Million lbs.	Population of the U.K. Millions.
1800.....	90	10	100	16
1820.....	100	10	110	21
1840.....	115	49	164	27
1850.....	118	60	178	27½
1870.....	141	174	315	31
1880.....	132	239	371	34½
1890.....	118	309	427	37½
1899.....	117	401	518	40½

We thus see that while the population has increased two and a half times in the century the quantity of wool used up has increased by more than five times, and that while a hundred years ago only 10 per cent. and fifty years ago less than 33 per cent. of our wool supply was of foreign origin, at the present time very nearly 400 per cent. comes to us over sea. The domestic clip has varied comparatively little in quantity throughout the century, and stands at present just where it did fifty years ago. The enormous totals of last year indicate faithfully the expansion of the Bradford trade, for there has during the past thirty years been but little growth in the industry in the West of England or Scotland.

What are the varieties and characteristics of all this mass of raw material and for what purposes is it destined? To answer these questions we must consider briefly the nature of the wool fibre. The difference between wool and hair is one of degree rather than of kind, all wool-bearing animals having a tendency if their cultivation be neglected to produce hair rather than wool. Dr. F. H. Bowman, F.R.S., in an admirable series of lectures on "The Structure of the Wool Fibre,"* shows that wool and hair are simply modifications of the same epidermal excrescence — a long cylindrical structure. But the fibre of true wool is always covered with numerous lorications or scales, the upper extremity of which are pointed rather than rounded in form, and these scales also have a much larger free margin than in the case of hair, being only attached for about one-third of their length, and in many cases the free ends are more or less turned outwards so that they present a more or less serrated or denticulated edge. The interior portion of the fibre, however, differs but slightiy from hair. The length and thickness of the wool fibre vary greatly in different breeds of sheep. Some is little more than an inch in

* Simpkin, Marshall & Co., 1885.

length and one-3500ths. of an inch in diameter, as in the finest Saxony merino, while fibres thirty inches or even more in length and one-fiftieth of an inch in diameter are found in the coarsest part of some deep-grown English sheep. The following may be taken as average diameters in decimals of an inch :—Lincoln wool ·00181, Southdown wool ·00099, Australian merino ·00051, mohair ·00170, alpaca ·00052, human hair ·00332. Speaking broadly, the length varies as the diameter, and, in the trade sense, fineness means quality, viz. : the capacity of being spun into finer counts of yarn. From very early times in England great attention was paid to sheep breeding with a view to improving the quality of the wool, and from twenty to thirty distinctly recognised varieties existed fifty or sixty years ago. Under the combined influence of a steady depreciation of wool values from the competition of imported wool and of an enhanced demand for a good butcher's carcase, many of these breeds have been lost by crossing. The coarse black-faced Scotch and cheviot, the long and lustrous Lincoln, the Leicester scarcely so long and not so lustrous, and the Down are, however, all standard types to-day which will probably persist by reason of their suitability to their peculiar habitat. For the rest they are now mostly lumped as "half-breds." On the continent of Europe there is also a wide variety of breed though much less attention has been paid to sheep culture than has been the case in England. The Spanish merino, acclimatized and improved by care in Saxony, is however, by far the most important on account of its intrinsic merits as a wool-producer. The fineness of merino wool and the special fitness of the animal for the dry plains of Australia and uplands of Cape Colony, led to the general adoption of the merino sheep by Colonial squatters, and the marvellous expansion of the world's wool supply during the past fifty years has been mainly due to the multiplication of flocks of the merino in Australia, New Zealand and South America.

Within the last fifteen years, however, a rapid development of the frozen meat trade—reaching to a total, last year, of nearly seven million carcases of mutton and lamb—has tended to modify the breed. The pure merino is a light carcased sheep and for killing purposes a cross with the Leicester or Southdown produces much better results. Such sheep are heavier and carry a heavier fleece, though the wool is not nearly so fine. But they require richer pastures and so the change has been most noticeable in New Zealand, Victoria and South America. In the latter case whereas twenty years ago 80 per cent. of the wool was merino, nearly 80 per cent. is now cross-bred. Coincident with this tendency to restrict the production of a pure merino, the Australian colonies have experienced an unprecedented succession of droughts lasting now for six years, during which the pastures of Queensland and large areas of New South Wales have enjoyed no soaking rains. The losses through the drought amount to 30,000,000 sheep, and they have occurred chiefly among the merino flocks. It is estimated that ten years of average seasons will be required to re-stock the "stations." Coming at a time of industrial expansion in Europe and the United States, the shortage of the supply of merino wool led to an extraordinary rise in the value of this material during last year, which was followed by a phenomenally sharp reaction in the first six months of 1900. On the other hand, the production of cross-bred wools has scarcely been checked, and as many millions of sheep are now annually raised for the frozen mutton trade the supply of such wool is likely to increase rather than otherwise until the appetite of the mutton-eating public is appeased.

Dr. Ure, in his "Dictionary of Arts and Manufactures" (3rd edition, 1846) roundly describes wool as "of two different sorts, the short and the long," and he goes on to point out that they are used for two different purposes, the short being carded and used for woollen cloth, the long

being combed and used for the worsted manufacture. This distinction between woollen and worsted fabrics is exceedingly puzzling to the uninitiated and as it is very closely related to the subject of this article a brief explanatory digression may be allowed. The difference consists not only in the length of the staple but in every process to which it is subjected from the time it is scoured to the finishing of the "piece," and is determined by the character of the end to be attained. In the spinning of a worsted thread the object aimed at is to arrange all the fibres parallel to each other and to twist them round the central axis of the thread, so as to produce a smooth, round, rope-like yarn. This characteristic of the yarn is preserved in the woven piece, all the lines in the design of which are clear and well defined. In the case of the woollen thread the parallelism of the fibres is purposely prevented. The carding and other preliminary processes are designed to cross them as much as possible, and the action of the spinning mule, on which woollen yarns are always spun, is such that while all the longer fibres arrange themselves more or less along the central axis the short fibres are thrown upon the surface and stand out like the hairs of a caterpillar. And in the woollen cloth the milling or shrinking, to which it is subjected, tends to accentuate this irregularity, and so to render the design indefinite and blurred. The characteristics of worsted are smoothness and hardness, of woollen they are roughness or "fulness" and softness. In the finishing of woollen cloths reliance is placed upon the felting property of wool. This property depends upon the scales upon the surface of the fibre to which reference has already been made, the free edges of which interlocking with those of adjacent fibres form a tangled mass. In a worsted the object is to avoid this, and as it happens that the shortest and finest wools are those which possess these imbrications to the greatest extent these wools are used mainly for woollens and so are termed

clothing wools, while the longer staples are termed combing wools and are used for worsteds. But there is a vast range of wools which may be used indifferently for either worsted or woollen yarn, and in the finished fabric it is not always easy to distinguish the one from the other.

Alpaca is a material which has played an important part in the history of the Bradford trade. It is the hair of a goat found only in the higher Andes, closely related to the llama. The alpaca is, however, smaller than the llama, and differs in other respects. It is remarkable for the length and fineness of its wool, which is of a silky texture with a very bright and silvery, almost metallic lustre. The fibre seems to occupy a position halfway between true wool and hair. In colour it ranges from white, through grey and yellowish brown even to black. The whole production of alpaca amounts to about 5,000,000 lbs. per annum, and it is practically all absorbed in the Bradford trade.

Mohair is the wool of the Angora goat, the home of which is in the hilly districts around Angora, a small town in Armenia. Constantinople is the port of shipment, and hence the trade term for the raw wool is Turkey mohair. But although indigenous to a small section of Asia Minor the Angora goat has been acclimatised in the Karoo district of Cape Colony, and its cultivation has been attended with marked success, both as regards the quantity of the clip and the fine quality and lustre of the product. In structure the mohair fibre is much more closely allied to true wool than is Alpaca, being more curly and "springy," but it possesses in a very high degree the same brilliance of lustre. Mohair is the material from which is manufactured the dress stuffs familiar to ladies by the term "alpacas," the true Alpaca fibre seldom being used for dress goods. It is also largely used for decorative "effects" in worsted goods and for braids, the coarser qualities finding an outlet in the manufacture of rugs and mantle cloths. The import of mohair for 1899 amounted to 25,650,852 lbs., valued at

£1,613,612. Of this total about 12½ million lbs. came from Turkey and ports in Asia Minor and 11½ million lbs. came from the Cape and Natal.

Cotton enters into the composition of many worsted and of recent years of not a few woollen goods. Its use in worsteds, though extensive, is almost confined to warp yarns, which are spun in Lancashire. Cotton cannot, therefore, be regarded as a staple in the Bradford trade. But in the cheaper woollen goods cotton is sometimes mixed with the wool or shoddy before the spinning process, and thus becomes an adulterant.

3.—PROCESSES IN THE WORSTED MANUFACTURE.

By JOHN BACCHUS.

A description of processes in the production of the textile fabrics manufactured in the Bradford district must for the purposes of this article be necessarily very meagre; first, because the variety of such fabrics is so great that each class to do it justice would require a description to itself; and secondly, because the raw textile materials used are very numerous, each variety of staple requiring its own special treatment. Bradford has always been famous for its manufactures of wool, and more especially of combed wool or worsted. But as its trade developed, various other staples have been introduced. Mohair, alpaca, camel's hair, silk, cotton, ramie fibre, and other textile materials are now largely used; and the brains of our designers and textile students are ever on the alert to discover novelties of combination and new processes of manufacture.

The four main branches of the worsted trade are:—I.—Combing; II.—Spinning; III.—Weaving; IV.—Dyeing and Finishing. It is only in a few cases that these four branches are all combined in one mill, the tendency of the trade having been for some time past to specialise on one or

other of the branches named. Several of the larger mills in the district, however, are engaged in the first three branches, and work up the wool from the raw state into the woven fabric, leaving the dyeing and finishing to be performed by those engaged in this special work. Other mills confine themselves to the first two branches, selling their product of worsted yarn to the weaving mills or to shipping merchants for export. Another class of mills confine themselves to combing alone; and there are numerous mills engaged solely in the weaving branch, buying their yarns from the spinners.

I.—Combing. This branch may be divided into the four following heads:—(1) Wool-sorting; (2) Scouring; (3) Carding; (4) Combing.

1.—*Wool-sorting.* The wool is received into the mill in large bales or sheets. The fleeces of wool are usually graded or classified roughly at the place where they are packed and shipped. But in order to prepare the wool properly, each fleece has to be divided up into a number of sorts by the process of wool-sorting. The sorts are determined by the fineness of the fibre and by the length and soundness of the staple; and the character and perfection of the yarn to be spun from the wool depends largely on the care exercised in this process. The wool-sorter takes his station in front of a large "board" or table, opens out the fleece, spreads it on the table, and then proceeds to take off the sorts. The finest and best wool is found on the shoulder and "rig" (or back) of the fleece, the medium sorts are taken from the sides, and the inferior sorts from the legs and "belly" of the fleece. Each sort has its particular name or number. The sorter throws his different sorts into baskets or skeps, which are ranged around him; and when these are filled the wool is taken away to be packed or stored in bins, ready for scouring when required.

2.—*Scouring.* Wool is washed in order to remove the

natural grease and other impurities. The percentage of weight of pure wool varies greatly in different classes of wool ; for example, English wools will yield as much as 70 to 80 per cent. of pure wool after washing ; Australian greasy wools will yield 45 to 55 per cent. ; while American territory wools will yield only 30 to 35 per cent. It is naturally a point of extreme importance for the wool-buyer to be able to judge the "condition" of the wools he has to purchase ; that is, to estimate the yield of pure wool from an unwashed fleece. The scouring machine consists of a series of tanks or "bowls," usually three in number, separated from each other by pairs of "squeeze rollers." Water and steam pipes are fitted to each bowl, with valves to empty the bowls when required. The bowls being filled with water, are heated by injected steam to the required temperature, about 120°F. ; and soap is put into the bowls in a liquid form, together with some mild alkali. The wool is fed into the first bowl of the series by a travelling "apron." When it falls into the scouring liquor it is gently passed along, in one form of the machine by a mechanical arrangement of moving forks, or in another form by a constant flow of water, aided by what are known as "possers" or pushers. When it reaches the end of the bowl it is caught by another travelling apron and conveyed to the squeeze rollers, which squeeze out the "liquor" and pass it to the next bowl. Passing through the second and third bowls in a similar manner it is finally thrown out from the third bowl by a "fan-roller" into a bin, by which time it is quite clean. It is then dried and afterwards sprinkled with olive oil or oleine to assist it in the next process—that of carding—after which it is collected and removed to the carding room.

3.—*Carding.* The object of this process is to put the wool into a convenient form for the subsequent process of combing. The scoured wool is put into a feed-box, which automatically passes it in regular quantities into the carding-

engine or "card." This machine consists of a series of cylinders of varying size, covered with "clothing," in which are inserted innumerable wire teeth, set more closely at the back end than the front end of the machine. The cylinders are made to revolve at high speed in close proximity to each other. Without going into details about the working of the card, it may be stated that the general effect of the process is to lash out the wool-fibres and lay them roughly parallel to each other. The wool is drawn off from the card in an endless ribbon or "sliver," and is coiled neatly into a ball, in which form it is removed to the combing-room.

4.—*Combing.* As its name implies, the object of this process is to comb out from the carded sliver the shorter wool, small lumps, and other extraneous matter. Wool-combing was formerly done by hand. The operator used a hand-comb, resembling a curry-comb, with which he carefully combed out the tufts of wool, removing the short material, or "noils," and laying aside to be spun the long fibres known as "tops." This operation is now performed automatically by the combing-machine. In that form of the machine which is mainly used in this district, the combs are circular in form, and consist of steel pins inserted in a brass ring. They are mounted on bed-plates, heated with steam, and two or more of such circles are made to revolve in contact with each other. The wool is "dabbed" or pressed into the circles at the point of contact, and the combing is done as the circles work away from each other. The long fibre is drawn from the comb circles by rollers, while the short fibre is left behind in the circles, from which it is removed by mechanical means. After combing, the slivers of "top," or combed wool, are passed through "gill-boxes," to straighten them and lay the fibres parallel. They are then ready for the spinning department.

II.—Spinning. The two main branches in this department are: (1) Drawing; (2) Spinning.

1. *Drawing.*—The object of this process is two-fold;

first, to draw out the wool slivers and reduce them to a convenient size for spinning the thread of yarn; secondly, to make them "even" or regular in size. This is attained by passing the slivers through a series of "drawing-boxes." The essential feature of a drawing-box is a combination of two pairs of rollers, the back pair of which revolves at a lower rate of speed than the front pair. Passing from one to the other the sliver is elongated in direct proportion to the excess of surface-speed of the front pair over the back pair. This proportion is called the "draught" of the box. Several "ends" of the sliver are put up at each box in order to attain regularity in the size of the resulting end, but the number of such ends must be less than the "draught" of the box, so that after each operation the resulting end is smaller. There are usually eight or ten operations in every drawing, and the last boxes are known as "roving boxes." From these boxes the sliver, which is now very small and known as "rovings," is sent to the spinning room.

2. *Spinning.*—This process is conducted in several different ways, according to the class of yarn which is being produced. The four principal systems are cap, flyer, ring, and mule spinning. The object of all is to produce the thread of yarn, and the process is simply an extension of the drawing process; but all the parts of the machine are in miniature, as the thread is so much reduced in size, and requires delicate handling. Yarns required for weft are put on to small spools and carried direct to the weaving-room. Warp yarn is usually made two-fold and twisted to give the strength required to stand the strain of weaving. After the twisting the warp yarn is removed on bobbins to the winding and warping-rooms, where it is put on to the weavers' beams in convenient form, a warp usually containing several thousand "ends" or threads. The warps are then conveyed to the twisting-room to be prepared for the looms, and thence to the weaving-rooms.

III.—Weaving is the art of producing cloth by the inter-

lacing of warp and weft yarns. The warp beam is placed on a stand behind the loom, the separate threads being drawn through the "healds" or "heddles," each heald carrying a certain number of threads. The healds vary in number according to the pattern which it is desired to produce. In simple weaving they are made to rise or fall by means of "tappets," carrying with them the threads which are drawn through them. Through the angle formed by the separation or "shed" of the warp threads, the thread of weft is passed by means of the shuttle, and as each thread of weft is thus passed through it is "beaten up" into the cloth in process of weaving by the "slay." The cloth is drawn off mechanically as fast as woven and wound on to a beam, and when a certain length has been woven, known as a "cut" or a "piece," it is cut off, unwound, and carried away. The three principal motions in the loom are thus:—(*a*) The "shedding," or separation of the warp threads; (*b*) the "picking," or passing of the shuttle through the space opened up by the shedding; (*c*) the beating-up of the weft into the cloth. These three motions are combined in the power-loom, and have to be accurately timed in relation to each other in order to ensure good work.

To weave the more complicated patterns, it is necessary to be able to use into one pattern more threads than in the simple class of weaving described above, and to make use of two or more shuttles for the weft. An attachment known as the "dobby" enables the weaver to utilise from ten to forty threads of warp in a single pattern; whilst by the aid of a "jacquard" machine, as many as 600 threads can be utilised. An attachment known as the "circular box" or "rising box" enables the weaver to make use of several shuttles, and so to introduce several different colours or kinds of weft.

The cloths, after weaving, pass into the hands of the "burlers," whose duty it is to remove imperfections; and from this department they are sent to the dyeing and finishing establishments.

4.—DYEING AND FINISHING.

By GEO. DOUGLAS.

The importance of dyeing in connection with the Bradford trade can scarcely be over-rated, as all the goods produced in the district have to pass through the process of dyeing or finishing. Indeed, from the magnitude of its operations and the large number of artisans employed, the Bradford dyeing trade might fairly take rank as a national industry.

Two requirements operate largely in fixing the position of the dyeworks, namely, the advantage of having a plentiful supply of suitable water, and of their being near the city in order to keep down the cost of carriage. The various dyeworks are therefore situated either in Bradford itself or in close proximity to it, and several of them cover an area sufficient for many a small English town. As a rule, each department is carried on in a separate building, a labyrinthine arrangement which, while geographically familiar to those engaged in the place, constitutes a sort of Hampton Court maze to the uninitiated.

The greatest bulk of the goods are dyed in the piece, that is to say, they are woven white, or, technically, "grey," and are afterwards dyed and finished in what are known as piece dyeworks. In the case of goods which are wholly or in part dyed before weaving, this dyeing is done either as yarn in the warp or hank dyeworks, or as loose wool in the slubbing dyeworks. The piece dyeworks are probably the most interesting, as in them are found not only the processes of colouring, but also the many operations connected with finishing the goods and turning them out in an attractive form.

It will, perhaps, be convenient if we give a general, but necessarily brief, description of the work carried on in these Bradford dyeworks. Noting the various processes of

steaming, singeing, and dyeing carried on in a piece dye-works, probably the impression left upon the mind of the visitor will be that of a sort of aggravated washing day on a large scale, for there is steam, steam everywhere. Commencing with the first process, he will observe the pieces being received "in the grey," or as they left the loom. After being carefully examined for defects, the pieces are stitched together in lengths varying from 200 to 500 yards, and sent to the "crabbing" house, where they are passed through boiling liquors and subjected to a thorough saturation by steam at high pressure. This process is necessary, in order to prevent the goods from crimping or shrinking during the subsequent operations of scouring and dyeing. The pieces are dried on great stacks of steam-heated revolving cylinders, and are now ready for the singeing process, which is somewhat remarkable in its character. During this operation, they are passed over red-hot plates at a very rapid rate, the contact being just sufficient to burn off any loose fibres protruding from the material without damaging the bulk. On emerging from this veritable ordeal of fire, the pieces have assumed a smoothness, glossiness, and lustre to which they were previously strangers, and are ready for actual dyeing.

It is now a question of what colours the merchant sending the goods requires them to be dyed, as the dyeing trade is entirely done on commission, or, in other words, the dyers simply apply their art to materials belonging to others. All-wool or half-wool goods are usually dyed in wooden becks or tanks containing the necessary dye liquors boiled by the injection of steam, the pieces being sewn in an endless length and kept in motion by being passed over a revolving drum. Cotton piece goods are dyed in the colour on "jiggers," or on "pads," by which they are passed in the open width through more concentrated dye liquor, either in the cold or partly heated; while "fast" or aniline blacks are passed also in the open width after

impregnating with the necessary material, through huge "ageing" or oxidising chambers. Assuming, then, that the goods have been dyed as ordered, they next receive the particular "finish" required by the merchant; they are "matched off" for shade, "cropped" and "tentered," *i.e.*, stretched out in width, and after being again carefully examined, are passed forward to the "pressing" department, when the pieces are folded, and glazed paper cards inserted by hand, after which they are placed between steam-heated plates in powerful hydraulic presses, and subjected to heat and pressure, and while still in position, cooled by passing a stream of water through the hollow plates. They are then taken out, and the paper cards are removed, the result being to give them a highly finished appearance. After being "made up," the goods are ready for the merchant's stock-room, or the draper's shop window.

Warp dyeing is applied entirely to cotton warps, and the processes necessary differ largely from those carried on in a piece dyeworks. Cotton warps are mostly spun in Lancashire, and are delivered to the dyer in large balls containing threads upwards of three miles in length. The balls are unwound from the inside, and the material is passed through a long series of tanks and squeezing rollers, in which they pass through, one after another, the various liquors necessary. Assuming the warps are to be dyed black, they are passed through a strong tannin solution which acts as a preparation for the dye, and next through a lime liquor, then through a salt of iron or copper as a mordant, and then, after washing, are passed through vats of logwood or other dyestuffs until the requisite density of colour is obtained. In colour dyeing, and especially where delicate shades are required, a first cleansing process of boiling and bleaching is necessary. Drying cylinders or stoves at a high temperature are called into action for drying cotton warps, and after passing through this process, and being made up into bundles, the warps are ready for the dresser, who prepares

them for weaving. Yarns of wool or cotton weft yarns are usually dyed in the hank, passing through similar processes, but, on account of being in shorter lengths, with more hand manipulation.

The "mercerising" of cotton consists in treating cotton under tension with very strong caustic soda, and is a means by which a lustre almost equal to silk is obtained. It is a very interesting process, and one from which many beautiful effects are obtained.

In a Slubbing Dyeworks, wool is sent to be dyed before being converted into yarn, and it is received in the "top," after it has been combed into a continuous length or "sliver." As a preparatory process, this material is subjected to a strong solution of soap and water and passed between revolving rollers at high pressure for the purpose of removing the oil used during the combing. It is then dyed according to colour and shade required in open steam-heated tanks, washed in similar tanks, and passed into a hydro-extractor driven at a terrific speed. After drying in hot stoves it is ready to be made up into bundles and returned to the spinner for recombing.

The melange or printing process employed in obtaining harmonious effects, consisting in printing fine bars of colour on the spread out band of wool, and then passing it through machines to thoroughly mix and intermingle it, possesses special features of interest, but must be passed over with this reference.

Although brief and general in its character, the foregoing will perhaps throw some light on the processes which may be seen on visiting a Bradford dyeworks. There are many features which appeal to scientific men, and among them those affecting the chemist obviously come first. Of course chemistry is largely in evidence in the laboratories of the great colour-producing firms who supply artificial colours to the dyers, but the work of the chemist does not end there, as his training and judgment are frequently called upon to

deal with the difficulties of carrying out, under the different conditions of actual work, the results of the laboratory. His skill is also taxed in fathoming the causes of defects and variations which are constantly being met with in the processes; or he is called upon to locate the cause of defect as between the various processes of dyeing and finishing and those of the previous manipulation in the manufacture of the goods. The chemist is also kept at work testing the various supplies to ensure that they do not vary and that they are kept up to standard, which means considerable labour on account of the great variety of materials employed. Before the chemist also lie many and fascinating possibilities in metamorphoses and physical changes and results to be obtained by chemical treatment, an additional impetus being given lately to his imagination by the remarkable developments of mercerising. This field is not confined to the purely chemical side alone, as the study of the physical effects of the application of heat, pressure, &c., is far from exhausted.

To the engineer the dyeing trade is interesting in that it lends itself largely to the development of electric motor driving, and the economical application of this system under the special conditions provides room for considerable study. There are before the engineer also innumerable opportunities for special devices in improvement of the machinery or in saving labour, one problem which has hardly yet been successfully dealt with being the removal economically of the clouds of steam which are given off in many of the boiling processes.

To the economist there is special interest in the fact that an agreement has been made between the employers and workmen through their Trades Unions, regulating wages and defining conditions of labour and agreeing that there shall be neither lock-out nor strike, but that all questions which cannot be settled by the immediately interested parties shall be determined by the arbitration of a Joint Board.

The business is further of interest to the economist on account of the lead taken by the dyeing trade in recent times in the formation of large trade combinations, the piece-dyeing trade being practically in the hands of the Bradford Dyers' Association Limited, and that of the Warp and Slubbing Dyeing in the hands of the British Cotton and Wool Dyeing Association Limited, both of which have their central offices in Bradford. These Associations are Joint Stock Companies, with a large part of their capital in the hands of the public, and they comprise, in each instance, the major part of the concerns engaged in the trade. While the establishment of these combinations is unquestionably undertaken from motives of self-interest, it cannot but be regarded as a tendency of the times, and the result of the pressure on the individual of extreme competition. The result in the long run probably hangs upon one point, namely, whether the new system can offer a sufficiently keen inducement to individual effort and enterprise, and can attract able men to the trade. The scheme adopted by these Associations is one under which a considerable part of the profit is apportioned to the active managers, each according to his own results, and the road is opened to energy and ability without the requirement of capital. The new system, by joining interests and controlling competition, provides a force which previously did not exist, and its appearance is apt to be looked upon with a certain amount of doubt. If this strength is merely used to extort unproportionate prices, it cannot last; but if it results, under the economies of combined working, in both benefiting the producer and giving the consumer better real value for his money, it will justify its advent—and this must remain for the future to adjudicate.

5.—MERCHANTING IN THE BRADFORD TRADE.

By FREDK. HOOPER
(Secretary, Bradford Chamber of Commerce.)

The merchanting system is of comparatively modern growth in Bradford. Wool merchants are said to have existed in the town for very many years, though it is difficult to find any early records of them, but up to the commencement of the present century other classes of local merchants were unknown. In the first Bradford Directory, issued about 1804, only one firm of stuff merchants is mentioned—that of Thos. & John Mann, who twenty years later gave an impetus to the trade by the introduction of soft wool goods for ladies' wear. This firm is again mentioned in the Bradford Directory for 1814, the only other stuff merchant's name mentioned being that of William Wilson. These were both "home trade" merchants, but they transacted a very limited business. At that time the bulk of the merchanting was done from Leeds, Halifax, Wakefield and London, though most of the then stuff manufacturers in the neighbouring districts attended the Bradford market with their goods. The pieces were purchased in the state in which they left the looms, and were afterwards, by the merchant's instructions, collected by the dyers—mostly from Leeds and Halifax. During the first decade of this century there were only two dyeing establishments in Bradford, but towards the end of the third decade several others were started. Bradford had then become "the metropolis of the worsted industry," and it was only about this time that the merchanting system really took root in the town. It is difficult to say which firms first followed the two merchants above named, but Messrs. Milligan, Forbes and Co., Messrs. Russell, Douglas & Co. (now Law, Russell and Co.), and Messrs. A. & S. Henry & Co.—all of whom are still carrying on business—were amongst them. German

and other foreign merchants, who had hitherto had their headquarters in Leeds or Manchester or had bought abroad through agents, then began to settle in Bradford, the first of these being Mr. Leo Schuster, who began business in 1830. A considerable number of foreign merchants afterwards settled in Bradford, and proved valuable acquisitions to the town. Many of them devoted much time and energy to the civic and other public duties which in course of time devolved upon them. The late Mr. Chas. Semon, for instance, was Mayor of Bradford in 1864, and founded the Semon Convalescent Home, and Mr. (afterwards Sir) Jacob Behrens was President of the Bradford Chamber of Commerce for several years, and rendered valuable services to the commercial community; indeed, the latter years of his life were largely devoted to furthering the commercial interests of the district. The sons and assistants of the foreign merchants above referred to, who now carry on the businesses then established, also display great public spirit, many of them being reckoned amongst Bradford's most worthy citizens. These firms all trade in yarns or pieces, or both, and, as might naturally be supposed, are mostly engaged in the foreign trade. Bradford owes much to these firms, for it was, in the first instance at any rate, mainly by their enterprise that Bradford goods were introduced into all parts of the globe, and are now known and used "from China to Peru."

There are of course large numbers of merchants in Bradford dealing in a variety of articles, but the principal classes of merchants connected with the textile trade are (1) Wool Merchants, (2) Mohair and Alpaca Merchants, (3) Top and Noil Merchants, (4) Yarn Merchants, and (5) Piece Merchants.

The Wool Merchant (or wool-*stapler* as he was formerly styled) is probably the oldest class of merchant existing in Bradford. Up to the beginning of the nineteenth

century the wool consumed in this country was almost entirely home-grown, the imports of foreign wool being either non-existent or very small. In those days the manufacturer himself generally purchased in the wool-producing districts, and after having had the wool combed and spun, gave out the yarn to be woven into pieces — combing, spinning and weaving being at that time done by hand, instead of by machinery as at present. To-day the Bradford wool merchant not only visits all the wool-producing districts of the United Kingdom, besides attending the sales of Colonial and foreign wools held periodically in London and Liverpool, but also imports wool from abroad, and after "sorting" it (*i.e.* grading the wool according to quality, staple, &c.) sells it to the consumer or the export merchant or makes it into "tops" for sale to the spinner or export top merchant. Some wool merchants deal only in English wools, others confine their attention to foreign and Colonial wools, whilst others deal in both kinds. Others again make a speciality of "short" wools and "noils"—the short fibres thrown out in the process of combing. Since 1860 the quantity of wool imported from abroad has been largely in excess of that produced at home, as will be seen from the following table, giving the imports of all kinds of wool and hair into this country in 1873 (the year of the last—and first —visit of the British Association to Bradford) as compared with last year :—

	1873.		1899.
Home-grown wool	lbs. 165,000,000	...	lbs. 140,000,000
Imports of Wool and Hair...	,, 325,000,000	...	,, 693,000,000
Together ...	,, 490,000,000	...	,, 833,000,000
Exported	,, 130,000,000	...	,, 315,000,000
Balance available for home consumption	,, 360,000,000	...	,, 518,000,000
Estimated value	£24,000,000	...	£20,000,000

At the prices of 1873 the wool consumed last year would have been worth about £40,000,000. Bradford, owing to

its large consumptive capacity and its facilities for distribution is now the centre of the English wool trade. Probably three-fourths of all the wool used in this country is consumed within a radius of fifteen miles from Bradford.

The Mohair Merchant imports mohair (the hair of the Angora goat) from Turkey or from the Cape, and after cleaning and "sorting" it (just as the wool merchant does with his wool) sells it to the spinner of mohair yarn. Some mohair merchants import only from Turkey, whilst others deal in the produce of both Turkey and the Cape. Mohair was hardly known as an article of commerce earlier than 1835, and in 1843 the imports amounted to only 575,000lbs. The imports of this article in 1873 and 1899 respectively were as follows :—

	1873		1899.	
	Lbs.	Value.	Lbs.	Value.
From Turkey.....	6,006,000...	752,600...	12,351,000...	902,500
From South Africa...	348,000...	23,850...	12,845,000...	693,800
From other countries	134,000...	12,550...	2,887,800...	47,200
Total lbs.	6,488,000	£789,000	lbs. 28,063,800	£1,643,500

The imports of Alpaca (mostly from Peru and Chili) amount to about 5,000,000lbs. per annum.

The Top Merchant makes or buys his "tops" and exports them to foreign countries. (Bradford spinners either make the "tops" themselves or buy them direct from the top maker). The export trade in "tops" is comparatively speaking a new trade. In 1882 (the first year for which statistics are available) the total exports of tops, noils and waste were valued at £90,442, whereas in 1898 the exports of tops alone had increased to 24,100,000 lbs., valued at £1,356,400. Germany, Russia, Italy, Sweden and Belgium are our principal customers for this article. The exports of "noils" amounted in 1898 to

12,000,000lbs., valued at £604,000, Germany and Russia between them taking more than half the total quantity exported.

The Yarn Merchant, like the top merchant, is engaged in the foreign trade exclusively. It is true that a few merchant firms in Bradford sell yarn to Bradford manufacturers, but these firms are mostly agents for Continental spinners or for Lancashire cotton spinners. It is worthy of note that this country imports annually from Belgium, Germany, and France woollen and worsted yarn to the value of nearly £2,000,000 sterling. This, however, is a class of yarn either not spun in Bradford or which it would not at present pay Bradford firms to spin. The Bradford export trade in yarns ranks next in importance to the export trade in pieces. The following figures shew how the trade has grown since 1873 :—

	1873.	1899.
Exports of woollen yarn	700,000 lbs.	... 1,200,000 lbs.
,, worsted yarn	34,000,000 ,,	... 62,500,000 ,,
,, mohair, &c., yarn ...	3,150,000 ,,	... 12,600,000 ,,
Total.....	37,850,000 lbs.	... 76,300,000 lbs.

In 1873 the value of the yarn exported was stated to be £5,878,000. In 1899, notwithstanding that the quantity was more than double that of the earlier period, the value was only £6,723,000. At the prices of 1873 it would have been worth nearly £12,000,000. Germany takes two-thirds of our entire exports of yarn, the remainder being distributed amongst the other Continental countries chiefly.

The Piece Merchant deals not only in the worsted, alpaca, mohair, and silk goods (including velvets and plushes) manufactured in the city and district, but also in the worsted suitings and coatings of Huddersfield and Halifax, the woollen goods of Leeds, Dewsbury, and Batley,

and the carpets, blankets, &c., of Halifax, Heckmondwike, and other places, in fact probably two-thirds of the entire productions of the West Riding are merchanted in Bradford. In addition to these articles, Bradford merchants have also a considerable trade in cotton dress goods, &c., manufactured in Lancashire but dyed and finished, or "mercerized" in Bradford. It must not be supposed, however, that the piece merchant is merely a middleman between the producer and the consumer. In Bradford the merchant undertakes many of the functions of the producer. Frequently he not only suggests the fabric to be made, but on receiving the goods from the manufacturer, often in the state in which they leave the loom, orders them to be dyed, embroidered or otherwise treated in such styles as his experience teaches him will suit the numerous markets with which he trades. If space permitted, it could be shewn that in several cases the merchants were the means of introducing new fabrics which at the time gave a distinct impetus to the Bradford trade.

Bradford Piece Merchants may be divided into two great classes, viz., Home Trade Merchants and Export (or Foreign) Merchants. The functions of each class are to a certain extent alike, the main distinction between the two being that the former confines his operations to the four divisions of the United Kingdom, whilst the latter deals only with countries outside our own borders. Some Piece Merchants do both a home and a foreign trade, whilst others (engaged in the foreign trade chiefly) deal not only in pieces, but in yarns and tops as well. In such cases, however, the different branches of business are kept quite distinct, and are usually carried on under separate management.

The Home Trade Merchant buys from the manufacturer and sells to warehousemen and wholesale dealers in London, Manchester, Glasgow and other parts of the country. These warehousemen re-sell the goods to drapers

and retailers generally in all parts of the Kingdom; it thus frequently happens that goods manufactured in this city are forwarded to London and are bought there and brought back to Bradford by local drapers. The Home Trade Merchant as a rule holds very large stocks, so as to be in a position to supply his customers at short notice.

The Export Merchant likewise buys the pieces direct from the manufacturer, and after having them dyed and finished, &c., and made up to suit the foreign market, *exports* them to foreign countries, the colonies, &c. The following table, giving the values of the exports of woollen and worsted goods to the principal importing countries, shews how the export trade in pieces has changed since 1873:—

Exports from the United Kingdom to	Woollen Goods.		Worsted Goods.	
	1873.	1899.	1873.	1899.
	£	£	£	£
Germany	948,100	533,100	2,857,400	335,000
Holland...	176,400	294,500	551,300	216,200
Belgium...	153,100	673,300	311,300	265,700
France	870,800	624,800	2,252,900	716,300
Italy	147,600	93,200	547,100	183,800
China	291,500	190,600	821,400	343,200
Japan	132,900	169,300	170,900	206,800
United States	1,197,400	363,400	3,941,500	785,600
South America	733,000	427,600	595,300	652,400
British South Africa ...	58,800	88,500	36,400	123,200
British East India ...	218,000	235,000	119,800	267,800
Australasia	538,800	479,600	798,900	756,100
British North America	418,000	310,900	339,500	567,500
All other countries ...	715,200	794,700	933,700	833,700
	6,599,600	5,278,500	14,277,400	6,253,300

The figures for 1873, however, are not absolutely reliable, and in comparing the two years it should also be borne in mind that prices in 1899 were very much lower, probably as much as 30 per cent. lower, than in 1873. Bradford goods have been the sport of tariff-makers nearly all the world over, and the above table shews the result. With a fair field and no favour Bradford merchants and manufacturers together

could compete with any other place in the world, but the prohibitive tariffs now in force in many countries—some of which were formerly our best customers—effectually exclude the bulk of our productions. Thus whilst we *import* annually from France alone £5,000,000 worth of dress-goods similar to those made in Bradford, all we can manage to send to that country in return is about £700,000 worth. Bradford merchants and manufacturers, however, are making great efforts to capture the home markets, and have already met with a large measure of success.

In the absence of reliable data, it is difficult even to estimate the value of the textile products merchanted in Bradford, but the pieces and yarns passing through the hands of Bradford merchants each year are probably worth about £35,000,000, to which must be added the value of the wools, tops, &c., that change hands. The turnover in the Bradford trade is probably not less than £90,000,000 per annum.

6.—THE IRON INDUSTRY.

By R. W. WICKHAM.

Though Bradford can hardly be classed as an iron-making district with such districts as those of Cleveland and South Staffordshire, it has the distinction of being the birth-place of the manufacture of the highest class of iron in the world. A village in the city has even given its name to this quality of iron, which is known as "Low Moor" iron, though it is now almost as well known as "Best Yorkshire."

The question where this class of iron was first made has always been in doubt, but it is certain that it was first produced by one of two firms—either at Low Moor or at Bowling, both of which places are situated in the present city of Bradford. The adherents of the Bowling

theory state that the Bowling works were established ten years before those at Low Moor ; but the supporters of the Low Moor claim equally stoutly affirm that their works first commenced operations. So far the point remains undecided, but it is known that the Low Moor works were started in 1788, though the first castings were not made till 1791. There were a few small works round Bradford previous to this date, but they had no lengthy existence, and have no interest at the present day. There is kept at Low Moor an interesting list of the castings for sale in 1799 made at Low Moor, and though the prices are such as many founders would like to be able to command in these days of severe competition, they are not nearly so high as might have been looked for at a time when the trade was in its earliest infancy.

The Bowling Works, in 1896, gave up the manufacture of iron owing to the exhaustion of their mineral field, though at the present moment a movement is on foot for the conversion of the old ironworks into a huge armaments factory. But at various times other works have been built for the manufacture of best Yorkshire iron, upon the lines of those at Low Moor and Bowling, the more notable of them being those of Messrs. Cooper (1827), the Farnley Iron Co. (1846), Messrs. Taylor Bros. and Co. (1857), and the Monkbridge Iron Co. (1854). The last three of these only are still working, Messrs. Cooper having closed in 1860.

The Low Moor Works, now a private limited liability company, known as the Low Moor Co., Ltd., had a somewhat ominous start in life, the old manor house of Royds Hall with the adjoining manors of Wibsey and North Bierley being bought from the assignees of Edward Leeds, Esq., who died insolvent in the year 1787 by his own hand. The property was twice—in 1786 and again in 1787—put up to public auction and withdrawn ; but in 1788 three gentlemen who owned some collieries at Bankfoot, in Brad

ford, secured it by private treaty. These three gentlemen were Mr. Richard Hird, of Rawdon, near Leeds, a wealthy country gentleman; Mr. John Dawson, a Nonconformist Minister; and Mr. John Hardy, a Bradford solicitor —a somewhat curious foundation for a great concern. The partnership, however, proved a fortunate one and the firm grew and prospered for 100 years under the title of Hird, Dawson & Hardy, when it became a company. After the purchase of the estate, the services of an engineer named Edward Smalley were secured, and in 1791 the original Boulton & Watt's blowing engine was erected, and at the same time two furnaces were built by Mr. Thomas Woodcock, a name ever since connected with Low Moor. This engine and the furnaces may still be seen, and the engine is even now occasionally worked. On the 16th of August in the same year the first cast was made, but it was not till 1801 that a forge was started at Low Moor. In this year "horse-nail" rods were rolled and other small bars, and in the following year forge hammers were erected. In 1803 the process of "puddling" and "refining" were begun, and in 1805 a small plant for rolling plates was put down. This was the basis of the whole manufacture, and what has been done since has been simply to extend the plant on the same lines as the demand for Low Moor iron increased. A new bar mill was put down in 1835, and a plate-mill in 1842; and in 1843 the first three-tons steam-hammer, made by Nasmyth, was erected. Since then many new hammers, puddling forges and refineries have been put down and two new plate-mills, the larger of these two mills being acknowledged to be one of the finest in England.

The Low Moor Company have from time to time by purchase and lease secured very large tracts of minerals, and supply themselves with all their raw materials. The ironstone is worked in conjunction with the "Black-bed" coal, a very good steam coal, just above which it lies; while the Better-bed coal, lying forty yards below the black-bed, is

from its peculiar freedom from sulphur the very best coal obtainable for coking and for other purposes in the manufacture of iron. That Low Moor iron should have withstood all competition for over 100 years is a sufficient guarantee of its quality and of the determination of the Low Moor Company to maintain the high repute of their manufacture. The business being solely in the hands of the direct descendants of the original founders, they may be said to have a family pride in the continued success of the firm. The present chairman of the Company is Mr. Lawrence Hardy, M.P. for the Ashford Division of Kent, and the other representatives of the Hardy family on the Board are Lord Medway, eldest son of the Earl of Cranbrook, and Sir Reginald Hardy, Bart. The Dawson family is represented by Mr. M. S. Dawson, now in South Africa with the Imperial Yeomanry, while the Hirds are represented by the descendants of the original Richard Hird's two daughters, Mr. W. W. Wickham, Mr. R. W. Wickham, and Colonel Charles Milligan.

As a large industrial centre Bradford is of course a large consumer of engines, boilers, and textile machinery, and in the district there are many firms engaged in the production of various classes of plant for textile mills. But with the exception of power looms and spinning machinery, which have in the past been largely exported to continental textile centres, Bradford does not produce anything important in the way of engineering or mechanics.

7.—STONE TRADE AND MINOR INDUSTRIES.

By A. R. BYLES.

Bradford is built of stone and, moreover, is the centre of a very important stone trade. The texture and character of the stone varies considerably in different parts of the

district, but it may generally be described as a fine sandstone or freestone. Most of the beds worked hitherto lie near the surface and are of great thickness. The stone is got in the open quarry, there being only one or two mines in the neighbourhood. At the Bolton Wood quarries, which are quite close to the city, a very fine white ashlar is got, which is largely used for public buildings and monumental purposes. At Idle, a brown ashlar and at Bowling a "blue" ashlar are obtained, both of which are extensively used in building. The Heaton, Allerton, and Thornton quarries yield a flat-bedded stone, much used for heavy landings, flags, and paving sets. A very large business is done in the export of stone from this district to all parts of the country, some important consignments having even been made to Australia. The number of quarries in the district in active operation is between forty and fifty, and the number of men employed is from 1200 to 1500.

8.—THE COMMERCIAL INSTITUTIONS OF BRADFORD.

By FREDK. HOOPER
(Secretary, Chamber of Commerce).

The Bradford Chamber of Commerce (Incorporated) was established in the year 1851, and during its existence has performed much useful and valuable work. It is one of the most active Chambers of Commerce, and has an excellent record. In point of membership it ranks seventh amongst the Chambers of Commerce of the United Kingdom, being only surpassed in this respect by the Chambers of London, Manchester, Glasgow, Dublin, Liverpool and Edinburgh.

Most of Bradford's leading business men—some of whom are of world-wide celebrity—have been connected

with the Chamber, either as presidents or as members of the Council. Amongst these may be mentioned Sir Titus Salt, Bart., M.P., Mr. S. C. Lister (Lord Masham), The Right Hon. W. E. Forster, M.P., Sir H. W. Ripley, Bart., M.P., Sir Henry Mitchell, and Sir Jacob Behrens.

The Chamber's ordinary operations comprise, amongst other matters, the following:—Advising the Foreign Office and other Government Departments on points connected with Bradford trade, especially when changes in foreign customs tariffs are impending; endeavouring to remove impediments to Bradford trade at home and abroad; promoting improvements in the postal, telegraphic and telephonic services; promoting or opposing commercial bills in Parliament; adjusting commercial disputes by means of arbitration; collecting and classifying statistics relating to Bradford trade; granting Certificates of Origin, foreign Commercial Travellers' certificates, and other documents required to facilitate foreign trade: verifying extracts of accounts, certifying patterns and samples; and furnishing information respecting foreign tariffs and trade matters generally; in short, fulfilling the functions of a local "Commercial Intelligence Department."

A complete record of the work accomplished by the Chamber since its formation would fill several very large volumes, but the following matters may be briefly mentioned as being a few of the reforms or improvements which the Chamber has been mainly or largely instrumental in bringing about:—The establishment of the Bradford Technical College, the Bradford Conditioning House, and the Board of Conciliation; the compilation of a Standard "Weavers' Wage List," and Standard "Yarn Contract Rules"; the drawing up of Regulations as to Woolsorting and Woolcombing (afterwards adopted by the Government); and reform of the laws relating to Bankruptcy, Bills of Exchange, Factories, Companies, &c. Probably the most

important work of the Chamber has been in connection with the development of the supply of Combing Wools. In 1859 it became apparent that the supply of wool was yearly becoming more and more inadequate for the ever-increasing demand. A "Wool Supply Committee" was therefore formed by the Chamber for the purpose of promoting the growth of Wool in India and Australasia and at the Cape. The Committee spent much time and money in sending out long-woolled sheep to India and the Colonies, and in advising Colonial breeders as to the best methods of producing the now well-known cross-bred sheep. The Committee also took an active part in promoting the growth of mohair (the hair of the Angora goat) at the Cape. The result of the Committee's operations was a large supply of long wools suitable for a great many purposes in this country. In 1859 the total imports into the United Kingdom of all kinds of wool and hair amounted to 68,000,000lbs.; in 1899 the quantity was 693,000,000lbs. It may be said without exaggeration that the work of the Wool Supply Committee of the Chamber has been one of the main factors in the building up of the great trade of Bradford and district.

The affairs of the Chamber are managed by a Council consisting of forty gentlemen, representing all the leading commercial interests of Bradford and district. The general body of members is divided into five Trade Sections, representing respectively the Wool Trade, the Spinners, the Manufacturers, the Yarn Merchants and the Piece Merchants. The President of the Chamber for the current year is Mr. W. A. Whitehead, J.P., senior partner in the firm of Messrs. W. & J. Whitehead, worsted spinners, Bradford.

The Exchange. — The first "Exchange" of which Bradford could boast was erected by public subscription in the year 1773. It was a building about fifty yards in length and eleven in breadth, on two floors, each floor being divided

into about 100 small rooms, in which piece-goods, worsted-tops and yarns were exposed for sale each market day (Thursday). A new Exchange was erected in 1828. This was naturally of a more pretentious character than its predecessor, and was designed to meet not only the commercial but the social requirements of the time. It cost £6000.

The foundation stone of the existing Exchange was laid by Lord Palmerston in 1864, the opening taking place in 1867. It is a handsome structure in the Gothic style of architecture, occupying a triangular plot of land fronting on Market Street. It is the property of a limited Company, with a capital of £37,500. The actual cost of the building, however, including subsequent structural alterations, is considerably in excess of that figure. The exterior of the building is adorned with statues of Bishop Blaize (the patron saint of Bradford woolcombers) and King Edward VI. (who granted a trading charter to Bradford), and with carved medallions of a number of eminent men—Cobden, Sir Titus Salt, Stephenson, Watt, Arkwright, Jacquard, Gladstone, and Palmerston being represented along the Market Street front, and Raleigh, Drake, Columbus, Cook, and Anson along Bank Street. The architects were Messrs. Lockwood & Mawson.

The greater portion of the building consists of a large hall—the Exchange proper—with a reading room attached. Here spinners and wool, top, noil, and yarn merchants meet daily for the transaction of business, the largest transactions taking place on the "market days" (Mondays and Thursdays). On these days the Exchange is crowded with traders, and presents a very animated appearance, especially at what may be termed "high 'Change"—from 12.30 to 1.30 p.m. Only members (*i.e.* persons paying an annual subscription to the Exchange) are admitted. There are about 2300 members, who come from all parts of Yorkshire and even from London, Wales, and Scotland.

The upper portions of the building are let as offices, the

Bradford Chamber of Commerce occupying a suite of rooms at the east, or tower end of the building, on the first floor. The Chairman of the Company is Mr. Charles Stead, J.P., and the Secretary, Mr. H. A. Swaine.

The Conditioning House.—The title of this establishment is somewhat of a misnomer, inasmuch as the institution does not "condition" anything. It *ascertains* the "condition"—*i.e.* the percentage of moisture, oleaginous matters, &c.—in wool, tops, noils, yarns, and other articles submitted for the purpose. Tests are also made as to the counts (thickness) and lengths of yarns, the tensile strength of yarns and woven materials, the component parts of woven fabrics composed of two or more materials, the thickness of fibres of wool or hair, and numerous other matters. These tests require the use of complicated and ingenious appliances, several of which have been invented by the manager Mr. Walter Townend.

The Conditioning House has been of great service to the Bradford trade, and is largely made use of by Bradford and other traders, as is evidenced by the following return of tests made during the year 1899 :—

Nature of Tests Made.	No. of Tests Made.
Wool, tops, noils, yarns, &c., for moisture.....	57,063
,, ,, ,, ,, for grease.....	6,107
Yarns, for counts, length, twist, strength, &c.	15,013
Analysis of cloths, yarns, &c. (various)	3,070
Total Tests in 1899.....	81,343

The fees received during the year amounted to £5,091.

The institution is under the management and control of the Bradford City Council, and is established under Parliamentary powers obtained in the year 1887, although it was not opened until 1891. It was for some years the only organisation of its kind in this country, but a similar institution has recently been established in Manchester.

The establishment of the Bradford institution was due to the action of the Bradford Chamber of Commerce, the project being originated in 1883 by Mr. Achior Hoffmann, a member of the Council. On that gentleman's death the matter was pressed forward by his son, Col. G. Hoffmann, who carried it to a successful issue during his term of office as President of the Chamber.

The Board of Conciliation was established in the year 1891 by the joint action of the Bradford Chamber of Commerce and the Trades and Labour Council. The Board consists of six members representing employers, elected by the Chamber of Commerce, and six members representing employés, elected by the Trades and Labour Council. Its objects are "To promote methods of amicably settling labour disputes and preventing strikes and lock-outs." During the first few years of its existence the Board had an active career, and rendered valuable services to the trade of the district by the number of disputes it was the means of settling on terms satisfactory to both sides. In one of these disputes (which was settled within a few days of its inception) no fewer than 6000 operatives would have been thrown out of work, and but for the action of the Board the trade of the town might have been seriously injured. Happily the services of the Board have not been requisitioned in recent years. The chairman is Colonel Hoffmann, and the joint secretaries are Messrs. H. B. Priestman and W. H. Drew.

The Worsted Committee was established in the year 1777, under Acts of Parliament passed in the 17th year of King George the Third, its object being the prevention and detection of frauds and embezzlements committed by persons engaged in the manufacture of wool, flax, cotton, mohair, silk, &c., in the counties of York, Lancaster, and Chester. The committee consists of eighteen members,

representative of all the principal business centres in the woollen and worsted districts. Inspectors are employed, and the committee institute prosecutions when necessary, securing on an average about a dozen convictions per annum. The expenses are defrayed partly out of a small invested fund accumulated some years ago, and partly by means of annual subscriptions from firms who recognise the importance of the committee's operations. The clerk to the committee is Mr. Frank Johnson, solicitor, Bradford.

III.—INSTITUTIONS.

1.—BRADFORD PARISH CHURCH.

By WILLIAM CUDWORTH.

The Parish Church of St. Peter's, Bradford, is naturally an object of historic interest, inasmuch as it is the most ancient building in the city, either secular or ecclesiastical. As seen from the centre of the town, the appearance of the church is decidedly imposing, and for the times in which it was erected, and the sparse population it was intended to serve, the sacred edifice must be regarded as highly creditable to the original founders. The more stately aspect which it now presents, owing to the recent restoration, is alike creditable to local Churchmen, and to the increased dignity which Bradford has gained in being advanced to the rank of a city.

There is little historical information as to the various periods involved in the early history of the Mother Church of Bradford parish. The present structure is said to be the third which has occupied the same site, and it is understood that it was erected during the reign of Henry VI., and was finished about the year 1485, having occupied upwards of twenty years in building. The tower was not completed until about the year 1508, or fifty years after the body of the church.

The first mention of a church at Bradford is in a York register of 1281, when Robert Tonnington was instituted to the rectory on the presentation of a member of the De Lacy family. The clerical duties were performed by a rector

until the year 1293, when the then rector presented one Richard de Hatton as vicar. From that date to the present, a period of over 600 years, there is an unbroken record of vicars, the present holder of the living (Dr. John Robertson) being the forty-seventh in the line of succession. The value of the living is £1200 per annum, and it is in the gift of Simeon's Trustees. Of the earliest Bradford church not a vestige remains. There is little room for doubt, however, that the present structure occupies the ground on which stood the Anglo-Norman church preceding it, and which, tradition has it, was known as "the chapel in the wood." Certain it is that the vicinity of Church Bank was formerly very woody, and until within a comparatively recent period the hillside extending in the direction of Windhill was well clothed with timber. In 1833, during certain works, fragments of an ancient cross, several sculptured stones, and portions of window jambs were found built into the south wall. Some of these stones were probably remains of the Norman church. Several of the capitals and bases of the piers of the south arcade are fair examples of the Early English style. As originally erected, the present structure consisted of nave, with north and south aisles, a chancel with side chapels, and a tower. In the nave and chancel the architecture was a somewhat debased form of the Perpendicular. The tower is considerably better in style. The outside walling of the north aisle is part of the building of the reign of Henry VI. The south aisle and porch were rebuilt in 1833, in a style "worthy of a railway viaduct engineer," as was remarked by the late Mr. Ruskin, while on a visit to Bradford. The chancel is of fine proportions. The chapel on the south side was originally a chantry, and was added by the Tempest family, formerly resident at Bolling Hall, near Bradford, and latterly of Broughton, near Skipton. That on the north side is known as the Leventhorpe Chapel, having been erected by members of a family once resident in the Thornton Valley, but long ago extinct

in this locality. The western tower is nearly as wide as the nave, from which it is divided by a lofty arch. It is of very substantial construction, and like the edifice of which it forms part is composed of heavy blocks of the local stone—millstone grit. The buttresses ascend from the base to the top of the tower, and the general appearance created thereby is that the builders intended to carry the structure somewhat higher than they actually did. On several of the stone courses on the lower flight there are a number of "mason's marks."

As has been indicated elsewhere in this handbook, the old Church was much in evidence during the Civil Wars, when Bradford was twice besieged by the Royalist forces. The townsmen, generally, sympathised with the Parliamentarians, and to fit the Church for use as a fortress, they hung sheets of wool upon that side of the steeple facing the road by which the Royalist army was expected to approach, and "so nigh the roof of the church that it would be with difficulty for a ball to penetrate the steeple." The precaution was not in vain, for the Royalist soldiers planted a battery of cannon about three hundred yards from the church, and began to fire away at the steeple, besides taking possession of some buildings nearer at hand for a like purpose. The damage done was slight.

The interior of the church was re-arranged during the year 1705, and in 1724 the mediæval oak roof in the nave, said to be one of the finest in Yorkshire, was concealed behind a plaster ceiling. The chancel roof, which is of oak, was similarly hidden. In 1785 the population of Bradford was under 5000, but such was the popularity of Vicar Crosse, known as the "blind Vicar," that the accommodation at the Parish Church became inadequate, and galleries were erected at the East and West ends and also along the North and South aisles. The pulpit was a "three-decker" of the old pattern, having a huge sounding-board overhanging it, surmounted by the figure of a dove.

The pulpit was occupied on one occasion by John Wesley. The organ and choir were accommodated somewhere aloft, in a receptacle above the western gallery. During the vicariate of Dr. Scoresby, the renowned Arctic seaman (1839-47), a scheme was formulated for removing the unsightly galleries and generally improving the interior of the church. Vested interests, however, proved too powerful for the reformers, and it was not until the year 1860 that the restoration movement was again revived. The huge gallery which overhung the communion table in the chancel and a very large one at the west end of the nave were then removed, but the north and south aisle galleries were allowed to remain, in deference to certain proprietary rights therein. The removal of the hideous excrescences in the chancel brought to light a good Perpendicular piscinæ in the south wall. In addition to other improvements carried out in 1860, the organ was brought down from aloft and placed in the Leventhorpe Chapel, appropriate oak stalls being erected for the choristers. The east window in the chancel was also filled with stained glass by the eminent firm with which the late William Morris, the poet-artist, was connected. The window is distinguished by that beauty of design and colour characteristic of the productions from the studio of the firm indicated, and was especially admired by Mr. Ruskin. The church contains many windows of stained glass, and is rich in monuments, several of them of elaborate character. One has been described as among the finest specimens of the sculptor's art existing in this part of Yorkshire. It is a personation of Age instructing Youth, from the chisel of the celebrated Flaxman, and is in memory of Abraham Balme, a Bradford gentleman.

Archdeacon Bardsley, during his vicariate, which extended from 1880 till his death in 1896, worked hard for the restoration scheme, in the face of many difficulties connected with the proprietary rights of pew owners in the two remaining galleries. Eventually he succeeded in over-

coming these difficulties, but his death occurred before the restoration scheme took practical shape. After his death it was thought that a restored church would be the most fitting tribute to the Archdeacon's memory, and the work was proceeded with upon that basis. The work was completed last year (1899), at a cost of about £12,000. The actual result cannot but be regarded with satisfaction alike by the congregation of the mother church of the parish and the citizens of Bradford generally. The ugly galleries in the north and south aisles of the nave have been removed, and their disappearance has been of immense advantage in developing the proportions of the building, while the addition of the two transepts, new vestries, &c., has materially increased its accommodation, although the vestries can scarcely be said to have improved the external appearance of the sacred edifice. The new vestries made it possible to restore the Bolling chapel, for long used as a clergy vestry, to its original use. In the additions recently made care was devoted to the preservation of the ancient staircase leading to the rood-loft which in pre-Reformation times existed in the church. Another mediæval feature brought to light was a hagioscope or "squint," which commanded a view of the high altar from a chamber erected on the site of the present vestries. The whole of the recent work of restoration has been carried out from the designs of Messrs. T. H. & F. Healey, architects, of Bradford.

2.—BRADFORD GRAMMAR SCHOOL.

By W. H. KEELING, M.A., and C. J. BATTERSBY, M.A.

In the earliest times the Grammar School stood close by the Church, and was used as a Choristers' School in connection with it. The first known date of importance in the history of the School is 1553, when the people of

Bradford instituted a suit to prevent certain Grammar School estates from lapsing to the Crown. During the troublous period of the Civil Wars the school suffered considerably. Steps, however, were taken to investigate and rectify its finances in the closing years of Cromwell's rule, and consequently, when Charles II. came to the throne, there was little to be done except to apply to him for a Charter of Incorporation confirming the school in its ancient rights. In 1662 the Charter was granted, and a Committee of Governors was appointed, one of whom, Peter Sunderland, presented the school with a silver seal, bearing the device of an open book with the words "Hoc age" inscribed on its pages. During the seventeenth and eighteenth centuries the school produced several distinguished pupils, among whom may be mentioned Joseph Lister, the historian of the Siege of Bradford; John Sharp, Archbishop of York; Abraham Sharp, mathematician and astronomer; Richard Richardson, F.R.S., a well-known botanist; James Scott, D.D., who as Anti-Sejanus wrote against Wilkes in the *Public Advertiser;* and Colonel William Sykes, M.P., an officer in the Bombay Army, and temporary Chairman of the East India Company.

The modern premises, which are the fourth set of buildings occupied by the school in the course of its existence, stand at the lower end of Manningham Lane. They were opened in 1873, nearly two years after the appointment of the present Headmaster, the Rev. W. H. Keeling, M.A., of Wadham College, Oxford. The money spent on the school and gymnasium amounted to about £30,000. In 1899, the Playing Field at Frizinghall was purchased for £8500, towards which Lord Masham contributed £1000. During Mr. Keeling's tenure of office the following benefactors have established Scholarship Endowments for boys going up to the Universities,—Mr. Henry Brown (£6000), Sir Titus Salt, Bart. (£6000), and Lord Masham (£4000).

The school was reorganised as a first-grade school in 1871. The Senior Department is divided into Classical and Modern Sides. On the Classical Side boys are trained for the Universities, on the Modern Side for commercial careers. There is also a Junior School with a Preparatory Department.

The number of boys in the school is 500, and the staff consists of twenty-three masters, of whom twenty are English University men. In the course of the last ten years the following University distinctions have been gained by the pupils:—five Fellowships, seven University Prizes, seventy-three College Scholarships, and thirty-four First-class Honours. Both the Governors of the School and the local authorities are anxious to extend to as many as possible the educational advantages of the institution. The Governors offer about thirty Scholarships to outside competition, while the City Council has this year granted £1000, and the West Riding County Council £200, for the maintenance of scholars. This generous policy has done much to place the school in its present position. Mr. A. P. Laurie, formerly Fellow of King's College, Cambridge, who in 1895 acted as Assistant Commissioner to the Royal Commission on Education, stated in his Report that, mainly through a liberal provision of Scholarships linking the Elementary Schools with the Grammar School and the Technical College, Bradford, is "an almost perfect example of an organised City scheme of education."

The following is the Committee of Governors:—

Ex-Officio—The Vicar of Bradford and the President of the Mechanics' Institute.

Representative — Aldermen W. W. Wood (Chairman), H. B. Ratcliffe, and J. Popplewell (City Council); W. A. Whitehead, Esq. (Chamber of Commerce); Alfred Priestman, Esq., W. Claridge, Esq., M.A., and the Rev. Canon Maguinness (School Board); Dr. J. B. H. Cohen (Victoria

University); Councillor Thomas Whiteley (West Riding County Council).

Co-optative — Sir Francis Sharp Powell, Bart., M.P., J. H. Wade, Esq., H. Behrens, Esq., M.A., James Drummond, Esq., and E. P. Arnold-Forster, Esq.

3.—SCIENTIFIC AND LITERARY INSTITUTIONS.

By RAMSDEN BACCHUS.

Among the oldest educational institutions in the city, perhaps the oldest after the Grammar School, is

The Bradford Library & Literary Society. This Society was founded in 1774, and although in the first years of its existence its position was quite insignificant, it has grown with the town and now possesses a collection of books comparing favourably with those of most provincial libraries. This arises from the fact that the accumulation of books has been continuous for 120 years, so that during this long period original editions of important works, especially in History, Philosophy, and Fiction, have been procured at the time of publication, rendering the collection one which it would be impossible to replace. There are about 450 members, each of whom is also a proprietor, as it is one of the rules of the Society that subscribers must buy a share in the Institution. The present building, which is situated in Darley Street, has been occupied by the Library since 1854, and was formerly the old Bradford Dispensary.

Another institution, which, according to the Bradford standard, is also of venerable antiquity, is

The Bradford Philosophical Society. Originally founded in 1808, it has passed through many vicissitudes, and has been threatened with extinction several times. At least twice in its existence it has lapsed into a dormant state, but after each of these lapses it has been revived and has

increased in energy and importance with each revival. A notable step was taken in 1839, during the presidency of Dr. Scoresby, the distinguished traveller, when the first attempt was made to form a Library and Museum. A prominent member of the Society at that time was Mr. Wm. Sharp, surgeon, who was instrumental in starting this museum, and received the fellowship of the Royal Society on account of his work at Bradford, and for a paper read by him at the Birmingham meeting of the British Association on "The Formation of Local Museums." Such museums, although now general, were then comparatively unknown—that established at Bradford being almost the first of the kind. Many distinguished men of science were hon. members of the Society at this period, such as Sir John Herschell, Sir David Brewster, Sir Roderick Murchison, Professors Sedgwick, Faraday, Lyell, and Owen. Great interest in this particular movement was taken by these eminent persons, and presents of books or specimens for the Museum were received from nearly all of them. Again, unfortunately, there followed a period of inactivity, and for some years nothing was heard of the Philosophical Society. However, in 1864, it was revived and established on a more important footing than it had previously occupied. A large sum of money was collected and spent in fitting up a suitable building, and in enlarging the museum. The geological collection of Mr. W. Richardson, of Southowram, was purchased, and other important collections were acquired. Professor L. C. Miall, who is now one of the Vice-presidents of the British Association, received his first public appointment as curator and secretary of the new museum.

In 1884, another important step was taken. Various other scientific societies existed in the town, and it was felt desirable that a union should be effected with these different bodies, so that they might be brought into touch with one another, while still remaining independent and carrying on the management of their own affairs. To

the Bradford Philosophical Society, therefore, were affiliated :—

The Bradford Scientific Association, of about 200 members, interested more particularly in Chemical and Physical Science and Geology ;

The Microscopical and Naturalists' Society, consisting of 40 members, who meet regularly to compare specimens and read papers ;

The Historical and Antiquarian Society, having 215 members, by whom weekly excursions are made during the summer to places of antiquarian interest, and papers are read during the winter at their periodical meetings.

This amalgamation has proved useful, and for many years past, the Philosophical Society has been in a very prosperous condition. It has a membership of more than 500 subscribers, many of these being family subscribers ; and its lectures, which are given by the most prominent literary and scientific men of the day, are attended by large and interested audiences. The Philosophical Society, it may be noted, can claim the honour of having taken the first steps to bring about the present visit of the British Association to Bradford. Two years ago, their Council passed a resolution requesting the Mayor to call a public meeting to consider the matter, with the result that an invitation was sent by the city to the British Association, asking them to visit Bradford in 1900.

4.—CHARITABLE INSTITUTIONS.

By H. BEHRENS.

The current income of the voluntary charitable institutions in immediate dependence on Bradford is, roughly speaking, about £22,000, whilst the expenditure amounts to upwards of £25,000.

The relative importance of the principal medical charities is shown by the following tables taken from the Reports for 1899 :—

Medical Charities.	Income.	Expenditure.	Beds for Men.	Beds for Women.	Beds for Children.	Total Beds.
	£	£				
Royal Infirmary	8203	10424	92	83	45	220
Eye and Ear Hospital	2454	2835	20	21		41
Children's Hospital	1991	2240	—	—	60	60
St. Catherine's Home for Cancer	581	678	—	25	—	25
Convalescent Homes.						
Woodlands	1359	1340	50	50	—	100
Ilkley	1595	1545	50	50	—	100

Besides the above, the more important charitable institutions are :—The Tradesmen's Benevolent Institution for aged and infirm persons reduced to comparative poverty, the Tradesmen's Home for the same, the Nutter Orphanage for Boys and the Orphan Girls' Home, the Charity Organisation Society, the Children's Holiday Fund, the Cinderella Club for feeding and clothing poor children, the Royal Infirmary Samaritan Society, and the Deaf and Dumb Institute. Of minor institutions there are at least a score ; indeed, it may be said that there exists hardly a form of distress without an agency in Bradford for its alleviation.

The Royal Infirmary supplies the needs of a wide and very populous district, which, though partly agricultural, is chiefly connected with the worsted and woollen industries. Woolsorters' disease is more commonly met with in the West Riding than in any other part of the country, though it is now a comparatively rare malady even here owing to the excellent measures which have been adopted in the mills to prevent infection. The other diseases which may

be said to occur with special frequency are those of the lungs and the heart—the latter being due partly to the hilly nature of the district and partly to the frequency with which rheumatic fever occurs in the neighbourhood. The Infirmary, in which about 15,000 patients are annually under treatment, was established in 1825, and occupied successively a small house in High Street and a building in Darley Street (now the Subscription Library) until 1844, when it was removed to its present site. It has undergone numerous enlargements—in 1864, 1873, 1885, 1894, and 1897.

The Eye and Ear Hospital (established 1857 and enlarged 1884) is widely known to be one of the best special hospitals in the North of England. A large proportion of the population of Bradford and the outlying districts is engaged in processes of worsted spinning and manufacturing, for which good eyesight is essential; and it is therefore not surprising that a considerable number of people should require to be supplied with spectacles, of which no fewer than 2360 were prescribed last year. Accidents are also very common, and altogether 970 major operations were performed in 1899. Of the 6000 patients who attended the hospital, nearly one-third suffered from injuries to the eye.

The Children's Hospital was established in Hanover Square in 1883 and removed to St. Mary's Road, Manningham, in 1890. The new building is constructed on the most modern principles.

At the St. Catherine's Home are treated cases of cancer, and diseases which, owing to their advanced state, are not admitted to the other hospitals.

The Workhouse Hospital, with accommodation for 450 patients, and the Fever Hospital, containing about 230 beds, are not generally included amongst the philanthropic foundations of a city; yet the administration of these rate-supported institutions is changing so rapidly from what it

used to be that they can no longer be dismissed as merely "necessary evils," but deserve to rank with the charities where efficiency and kindly treatment of the patients are the first consideration.

5.—EDUCATION.

By W. CLARIDGE, M.A.

Until comparatively recent times the educational history of Bradford was mainly comprised in the records of the Bradford Grammar School—the oldest corporate body in Bradford. The earliest existing charter of the school is dated 1662, but it contains references to lands, tenements, and rents already belonging to the foundation, and it is clear that this charter of Charles II. is but a confirmation of previously existing rights. Indeed, almost exactly a century before, in 1563, it appears from a document now in the Bradford Free Library, that certain property belonged to the School, and had long been managed by a number of Feoffees or Governors, appointed for the purpose by the inhabitants and parishioners of Bradford. It set forth that certain rents be paid "to such Scole maister or Scole maisters as shall by the assente of Sir John Tempest, William Jacson, Nychollas Tempest, John Lacye, and others (being the Governors referred to) be appointed from tyme to tyme to kepe the free Scole within the towne of Bradforthe, and there teache and brynge up Scoleres in vertue and learnynge accordynge to one compossysyon concernynge the said free Scole maid by the said parishioners." This matter of the absolute control of the School under a Scheme or "compossysyon" drawn up by the parishioners seems to have long been a burning question. Ten years before, in 1553, the Commissioners "appointed to inquire for chauntries and such other like things" on the suppression of the smaller monasteries had laid their hands on some of

the Grammar School property. The parishioners resented the claim, and proved their case to the satisfaction of the "Chancellor and Councill." The finding runs that the property in dispute "was given towards the living and sustentacion of a Schoolmaster teaching grammar within the said town of Bradford, and the King's (Edward VI.'s) Majestie is not entitled thereto by any article or braunch contayned in the Statute of Chauntries, &c., and it is thereupon ordered and decreed that the parishioners of Bradford shall enjoy the said lands without any further trouble until such time as better matter be shewed in this Court to entitle the King's Majestie thereunto. Westminster, 20 May, 1553." It was likewise shown that the property had in 1553 "anciently" belonged to the living and sustentation of a schoolmaster. Another document is extant showing the names of the Governors in 1593, together with a schedule of property belonging to the trust. Again in 1601 a dispute arose as to the property of the School, and at an official inquiry at Elland it was held to be demonstrated that the property did belong to the School, and had so belonged "time whereof the memory of man was not to the contrary."

The next interesting dispute in the history of the School arose in 1633. John O'Kell, a pronounced Puritan, was then Vicar of Bradford. His principles and practices, and especially the building of galleries or "lofts" in the Parish Church, offended the High Church party, and the Archbishop of York summoned O'Kell and other delinquents before the Court of High Commission at York. Among those who fell under the Archbishop's ban was "William Wilcocke, ye scolemaister," who, according to an extant letter addressed to Lord Fairfax, was a "right able and honest schoolmaster," but unfortunately a Puritan. While affairs were in this state Wilcocke died and the Archbishop did not hesitate to dragoon the parishioners by appointing as head master Gervas Worrall, son of Dr. Worrall, who it is

said was Archbishop Laud's chaplain. This was keenly resented by the parishioners, and as firmly persisted in by the Archbishop. The immediate issue of the dispute was that the Vicar had to eat humble pie and put his name to the following extraordinary document :—

To the Right Reverend Father in God and Lord Richard, by the Divine Providence Lord Archbishop of York, Primate of England and Metropolitan, and one of His Majestie's Most Honble. Privy Council, &c.

May it please yr. Grace to be advertised

That Gervas Worrall, Bachelor of Artes, now Schoole master at Bradford hath entered into the Schoole there and doth peaceably possess and enjoy the same without disturbance of any man. All wch., according to yr. Grace's pleasure expressed unto us at our last beinge at Bishopthorpe, wee do humbly certifye unto yr. Grace. And so in all humilitie doe take our leaves this 19th day of August, Anno Dni., 1635.

JOHN MAYNARD,
JOHN O'KELL,
H. MIDGLEY,
GERVAS WORRALL.

But Bradford did not sit quietly down under the rebuff. On Feb. 4th, 1641, a petition was presented to the House of Lords setting forth that certain lands had been given to the parish for the maintenance of a schoolmaster "to be elected by the parishioners," and that these lands had been so enjoyed for many years. "But four years ago one Gervas Worrall was appointed schoolmaster by the Archbishop of York without the consent of the parishioners, and the petitioners who opposed the nomination were questioned in the High Court of Commission at York, and put to much expense, and they pray that the right of election of the schoolmaster may be declared to belong to the parish." Apparently before an answer was given the Civil War broke out (1642), and Bradford men took a prominent part in the fighting. Both the Church and the School, which at that time adjoined the Church, were the scenes of bloody combats, and the principal local historian of the Civil War hereabouts was a Grammar School "old boy," Joseph

Lister. The present Post Office partly covers the site of this early Grammar School. During the Commonwealth the Commissioners for Charitable Uses vigorously set to work to rebuild the shattered fortunes and reputation of the School. They forced reluctant holders to "disgorge" Grammar School property which had for some time been appropriated, and in their own right they appointed a new head master, Thomas Watkins; we hear no more of Gervas Worrall. They emphatically declared that the appointment and dismissal of the master and the control of the School estate lay with the Governors. In 1655 they drew up a schedule of property which differed from that of 1553 in no important respect, and petitioned Parliament for a Charter of Incorporation. Meantime the Commonwealth tottered and fell, and it was this petition, with modifications to suit the character of the times, that formed the basis for the Charter of 1662.

How much further back than 1553 the Grammar School existed cannot positively be declared. All we know is that after inquiry it was officially declared that the endowments were "ancient" at that date. In all probability the Grammar School had its origin in a Choristers' School attached to the Parish Church, and its endowments were a gradual accretion from an early date. That schools were numerous before the Reformation is abundantly proved, and as early as 1406 the Statute of Artificers declared "that every man or woman of what sort or condition that he be, shall be free to set their son or daughter to take learning at any school that pleaseth them within the realm."

The history of the Bradford Grammar School from the Restoration to 1870 was intimately bound up with the domestic life of the town. Like other Grammar Schools its fortune was very varied; sometimes it was prosperous; at other times it was in a deplorable state of neglect and inefficiency. As a protest against the low educational condition of the school, the Bradford High School was

established about 1860, and the present Grammar School was due to the amalgamation of the High School and the old Grammar School in 1871.

In 1870 Mr. W. E. Forster—then Member for Bradford—carried the Endowed Schools Act, and the Bradford Grammar School was the first school reconstructed under the Act. The scheme of the Charity Commissioners only proposed to make the school a Second Grade School, and a vehement discussion arose in Bradford as to whether the school should be of the first or second grade, and whether Greek should be taught or not. Bishop Ryan, Sir Jacob Behrens, and Mr. W. Byles strongly urged that the school should be one of the highest grade, and that they succeeded in their efforts is a matter for which thousands of scholars and parents will ever bear grateful thanks. The endowment, which had hitherto consisted of landed estates, was now transformed into Government securities which realised a nominal income of £750 per year, which was, however, heavily taxed with a pension of £160 to the late head-master, and was further diminished by an annual payment of £250 to the Girls' Grammar School. The whole of the residue of the endowment is, and always has been, expended on Governors' Scholarships and Exhibitions.

In addition to the Grammar School proper, a Girls' Grammar School, the first of its kind in the kingdom, was opened in 1875, the foundation of such a school being provided for in the reconstruction scheme propounded by the Charity Commissioners in 1871. From its foundation to the present day the history of the school has been one of steady progress and development till now, from its connections with the Universities, it is one of the principal public girls' schools in the kingdom.

Of private enterprise in educational work Bradford has had its share of hard working pioneers. The building in which the Girls' Grammar School is housed was itself due to the enterprise and faith of one of these pioneers. It

would be invidious to single out names, but it would be an easy matter to record a few conspicuous instances of both men and women, who, rising above the state of educational decay which preceded 1860, threw themselves with energy into the task of providing privately what was missing in the educational machinery, such as it was, in Bradford. These names will ever be held in grateful remembrance by those who were indebted to them for their zeal and enthusiasm.

Let us now take a glance at primary education.

At the time of the introduction of the Elementary Education Act by Mr. Forster, the population of the borough was 146,987. As a rough and ready estimate it was considered a safe rule to regard one-sixth of the population as of school age. On this basis there ought to have been 24,498 children in attendance at the schools. As a matter of fact there were only 14,204 scholars on the registers of all the elementary schools of Bradford, and there was not sufficient accommodation for the rest.

From this time forward progress has gone on by leaps and bounds, not only in regard to the number of the scholars, but in the character and equipment of the schools and in the quality and variety of the instruction, till to-day a keen observer who has been visiting schools in all parts of the United Kingdom, on behalf of one of the Australian Governments, places Bradford in the very first place as regards the thoroughness of the education imparted in its primary schools. Ten years after Mr. Forster's Act had been in force the population had grown to 184,037, and the Bradford School Board had provided places for 19,352 scholars, and no fewer than 18,880 scholars were in average attendance. After another decade had passed, the population had increased to 226,384, and the accommodation provided by the Board and voluntary agencies was for 49,719 scholars; the number of children on the rolls was 40,503, of whom 27,450 were in Board schools. Coming now to the present

time, and including the new areas added to the city in 1899, there are now forty-eight Board schools with 118 departments, and forty-two other schools, with seventy-four departments. As showing the immense strides that have been taken since Mr. Forster's Act came into force, it is sufficient to point out that there is now accommodation in Bradford Board schools for 38,843 scholars, and in other schools for 23,255 scholars.

Side by side with this gigantic growth in numbers, the changes in the type of school have been no less striking. The most momentous change has been the development of the Higher-grade Board School system. The credit for this great work is largely due to the late Mr. James Hanson, and in grateful recognition of his services one of the higher-grade schools has been named after him. Of these schools there are now five in Bradford, and they are attended by over 2000 scholars. Two of them include schools of science, and, according to the recent Government inspection, they rank amongst the most efficient in the kingdom. They are open to all scholars who have passed out of Standard 6, and include some 550 scholars. The work of the higher board schools in stimulating a desire for still higher work is admitted on all hands, and is one of the primary causes of the educational pre-eminence which Bradford enjoys.

In order to give to the citizens of Bradford the fullest opportunity of availing themselves of the provision thus made, the Board has provided no fewer than 700 free scholarships tenable at the higher grade schools and the schools of science; and with a view to securing equality of opportunity for all, the primary schools of Bradford have been divided into six sections, and a pro rata number of scholarships has been allotted in proportion to the number of scholars on the registers of each section. The first section comprises all schools in the poorest parts of the city, where parents cannot give as many facilities to their children for study as in the more favoured districts, and

in this way the whole city has been mapped out, so that scholars compete as far as possible only against scholars in the same social condition as themselves. In addition, there are about thirty maintenance scholarships of £7 10s. each, limited to those scholars whose parents cannot afford to forego the wages that the children are capable of earning. It is much to be desired that this class of scholarship should be largely increased. The free scholarships are given in the first instance for two years only, but are renewable for a third, fourth, or even fifth year, in cases where the progress and conduct of the recipients justify the extension.

Amongst other special features of the Board's work may be named the School for Blind Children, of whom there are eighteen on the roll. There is also a most interesting school for the oral teaching of deaf children, of whom there are twenty-six. An excellent gymnasium has been provided for these two schools; both blind and deaf are taught manual work, including woodwork, cane weaving, clay modelling, brush drawing, &c. This feature of the Board's work is particularly interesting, as it forms part of a strong attempt by the Board so to equip these children that they may be able to earn their living in after life as ordinary citizens. An inspection of the remarkable specimens of woodwork produced by blind and deaf children will enable visitors to judge how far this experiment is succeeding in its aim.

In addition to the manual work at the blind and deaf centres, there are now six manual instruction rooms, where wood and metal work are taught to some 1250 boys; there are twenty-two cookery centres, in which 2700 girls are taught practical cookery, and the principles on which cookery should be based; there are three laundry centres, where 500 girls are taught; and one centre for swimming (at Wapping Road), containing a large plunge bath, together with a number of slipper baths. Over 300 boys and girls are weekly taught at this centre, and the Board contemplate providing other baths in the near future—if

possible, in conjunction with the Corporation authorities. Another interesting department of the Board's work is shown in the provision of five special centres for children who, from physical or mental causes, are unable to keep pace with ordinary scholars in the schools. At present there are eighty scholars in these centres. Bradford set the example to the rest of the country in being the first Board in the kingdom to introduce the half-time system in regard to pupil teachers. The central classes for the training of these teachers are now amongst the most successful in the country. The latest development of the Board work is an Elementary Commercial School, recently opened at Carlton Street. The total teaching staff in the Board day schools is now 1004. Besides this army of teachers employed in the day schools there are some 370 engaged in the evening schools.

The evening schools of Bradford have been for many years most successful. The subjects taught are extremely varied. Great interest has been awakened in the subject of evening schools amongst the working classes. Local co-operative societies have taken up the matter earnestly, and are co-operating with the Board in the promotion of special classes, and offering prizes and medals to the most successful pupils. During last session there were sixty evening schools with 7000 students, fifty-eight science and art classes with 1150 scholars, twenty-seven certificate classes (for teachers) with 110 students, thirty evening language classes with 700 students, and ten other classes, for teachers, in cookery, clay modelling, dress-making, &c., and five matriculation classes. One of the most interesting features of this evening school work is the language classes, which are very popular, and provide some 700 men and women with excellent instruction in French, German, Spanish, and Italian, the four principal languages in which the commerce of Bradford is conducted. The cost of all the above classes, with the exception of the evening

continuation schools, is met out of the "whisky money" voted by the City Corporation, and if more were granted a very valuable development of this important work would be possible, and would meet with popular approval.

IV.—SCIENTIFIC SECTION.

The district included in the Botanical and Zoological articles is roughly the drainage system of the River Aire and its tributaries, from its source to about Kirkstall Abbey. As might be expected, the richness of the fauna and flora increases with the distance from manufacturing centres, and many species of plants and animals which were no doubt abundant in the immediate neighbourhood of Bradford in former years have become extinct. Most of these survive in the districts of similar physical structure in the neighbourhood of the Aire valley. Local naturalists have worked the district under review with considerable thoroughness, and a fairly systematic examination, and record of the occurrence of the species of our flora and fauna has been undertaken by the Bradford Naturalists' Society. It cannot be said, however, that the district has been thoroughly examined, some orders, especially of the Insects, have not been worked at all, and much greater attention has been paid to some orders than to others.

1.—BOTANY.

By WILLIAM WEST, F.L.S.

The flora of the immediate neighbourhood of Bradford is not so rich in species as it was some twenty or thirty years ago, owing to the rapid extension of the suburbs, still it yields a considerable number of species, considering the nature of the soil, consisting of the Lower Coal Measures and Millstone Grit. The hilly nature of the district, (the elevation being 340 feet on the ground at the Town Hall) imparts a sub-alpine character to much of its flora and thus renders it more interesting. The sylvan component too

adds still further variety. The district lies entirely in Watson's Mid-agrarian zone. The mean Summer and Winter temperatures are about 60° and 36° respectively, the difference being about 24°, whereas on the Yorkshire Coast the difference is only about 17°. The annual mean rainfall is about 35 inches. I have not space to dilate on these *data* but simply state them, in order that the reader may note them as factors in the determination of the constituents of the Flora.

The frequency of such moisture-loving sub-montane species as *Crepis paludosa*, and shade-loving species like *Stellaria nemorum*, at once asserts that the visitor is not in the south of England ; while the total absence of many plants very common in the south cannot fail to be noticed by any observer—such as *Clematis*, *Viburnum Lantana*, *Cuscuta Epithymum*, *Solanum nigrum*, *&c.* Again the elevation above sea-level accounts for the absence of many plants which go further north, such as *Thalictrum flavum*, *Nasturtium amphibium*, *Drosera intermedia*, *Sium latifolium*, *Carduus pratensis*, *Rumex Hydrolapathum*, *Typha angustifolia*, *Juncus obtusifolius*, *Lastræa Thelypteris*, *&c.*

The number of Vascular plants which undoubtedly occur in the district within six miles is about 600, and these are mostly on the north-west side of the town. These are enumerated in the records of the Bradford Naturalists' Society. The Cryptogams, also on the records of the same Society, are more than twice as numerous.

The mere stream on which Bradford is built sadly lacks pellucidness ; it flows into the Aire about three miles from the centre of the town, and thereby increases the specific gravity of the far from limpid water of the river ; the matter in suspension also is by no means a small amount. The effect is at once apparent by the immediate appearance in large quantity of that interesting thiophilous plant, *Beggiatoa alba*. One looks in vain on the stones in the river for the commonest mosses, such as *Fontinalis antipyretica* and

Rhynchostegium rusciforme, and even for such a common algæ as *Cladophora glomerata*, yet riparial pseudothiophilous plants like *Sisymbrium Alliaria* and *Barbarea vulgaris* are evidently at home and exceptionally luxuriant. It may also be noted that it is perfectly useless to search the trees here for the merest scraps of those soot-hating dual organisms—the Lichens, as well as for mosses belonging to such genera as *Orthotrichum* and *Ulota*.

Pelophilous species abound, such as *Ranunculus Flammula*, *R. Ficaria*, *Stellaria Holostea*, *Lychnis diurna*, *Hypericum tetrapterum*, *Lathyrus montanus*, *Lonicera Periclymenum*, *Hieracium boreale*, *Tussilago*, *Bidens tripartita*, *Solanum Dulcamara*, *Lathraea squamaria*, *Juncus bufonius*, *Scilla nutans*, *Equisetum arvense*, *&c.*

Psammophilous species are represented by *Corydalis claviculata*, *Hypericum humifusum*, *Ononis arvensis*, *Cytisus Scoparium*, *Alchemilla arvensis*, *Artemisia vulgaris*, *Jasione montana*, *Teucrium Scorodonia*, *Rumex Acetosella*, *Salix repens*, *Luzula sylvatica*, *Carex laevigata*, *Aira praecox*, &c.

Hygrophilous species growing on the sandy peaty soil of the moors are represented by *Montia fontana*, *Drosera rotundifolia*, *Potentilla comarum*, *Hydrocotyle vulgaris*, *Erica tetralix*, *Vaccinium oxycoccus*, *Trientalis europæa*, *Myosotis repens*, *Empetrum nigrum*, *Narthecium ossifragum*, *Scirpus setaceus*, *Eriophorum angustifolium*, *Carex curta*, *C. echinata*, *Molinia coerulea*, *Agrostis canina*, *Nardus stricta*, *Nephrodium Oreopteris*, *&c.*; while those hygrophilous species more in connection with the soil, which is composed chiefly of weathered millstone grit, are in evidence also, such as *Anemone nemorosa*, *Hypericum pulchrum*, *Cerastium triviale*, *Polygala depressa*, *Galium saxatile*, *Erica cinerea*, *Calluna vulgaris*, *Vaccinium vitis-idæa*, *V. myrtillus*, *Digitalis purpurea*, *Salix aurita*, *S. Caprea*, *Scirpus cæspitosus*, *Eriophorum vaginatum*, *Carex binervis*, *Aira flexuosa*, *Juncus squarrosus*, *Agrostis vulgaris*, *Holcus mollis*, *Festuca ovina*, *Nephrodium dilatatum*, *&c.*

Ulex Gallii is an abundant and interesting plant on account of both its characteristic morphological and its adaptative histological character, being quite as interesting as the Broom and the leaves of many other moorland plants.

A frequent handsome shade-loving plant is *Campanula latifolia*, and it is quite as abundant in the mountain limestone districts as it is in the coal measures.

Many xerophilous species, which are considered by some to be within the district, can soon be reached by rail if one cares to go about twenty miles up the valley into the mountain limestone district. Here Digitalis, Calluna, Erica and other plants are totally absent, but other interesting plants appear, for instance the peculiar, rare, as well as local *Actæa*, *Thalictrum montanum*, *Hutchinsia*, *Draba incana*, *D. muralis*, *Thlaspi occitanum*, *Geranium sanguineum*, *Geranium sylvaticum*, *Hippocrepis comosa*, *Ribes petraeum*, *Poterium Sanguisorba*, *Rubus saxatilis*, *Pyrus rupicola*, *Scabiosa columbaria*, *Polemonium cæruleum*, *Taxus*, *Convallaria*, *Polygonatum officinale*, *Epipactis ovalis*, *Ophrys muscifera*, *O. apifera*, *Melica nutans*, *Sesleria cærulea*, *Cystopteris fragilis*, *Nephrodium rigidum*, *Polypodium Robertianum*, *&c.* Here also at Gordale is a true Highland type, *Carex capillaris*, where it reaches its southern limit in Britain, its next nearest station being Upper Teasdale.

Primula farinosa abounds on wet limestone pastures with *Scirpus caricis* and *Selaginella Selaginoides*; *Galium boreale*, *Pyrola minor*, *Salix phylicifolia*, *Polygonum viviparum* and *Dryas octopetala* also occur. If the visitor is desirous of climbing one of the higher hills like Ingleborough or Penyghent, he can then see in their native habitats, *Daphne Mezereum*, *Sedum Rhodiola*, *Saxifraga oppositifolia*, at 2,000 feet; *S. hypnoides*, *S. aizoides*, *Rubus Chamæmorus*, at 1,500 feet, *Listera cordata* above 1,000 feet, *Carex rigida* at 2,000 feet, *Lycopodium alpinum*, *L. selago* and *L. clavatum*.

September is by no means the best month for a

botanical ramble unless one is also a student of cellular cryptogams, it then matters little at what time of the year he happens to be anywhere, as he can always harvest more than he can possibly investigate. In the immediate neighbourhood a large number of the Fungi will have begun to appear, and the investigating fungologist will soon have his hands full, whether he studies the larger genera such as *Amanita*, *Tricholoma*, *Mycena*, *Hygrophorus*, *Coprinus*, *Boletus*, &c., or the smaller genera like *Sphæria*, *Peziza*, *Ascobolus*, &c. The remarkable organisms termed Myxomycetes are also plentiful in the district.

If the Muscineæ are being sought after, a large number of species can be obtained in the glens and woods. The gemmiparous *Georgia* (*Tetraphis*) *Pellucida*—which so reminds one of a *Jungermannia*, abounds both on tree-stumps and on the peat of the moors—*Aulacomnium palustre* and *A. androgynum*, but one may look for ever (in the near neighbourhood) for the gemmiparous mosses *Orthotrichum Lyellii* and *Ulota Phyllantha*. Six species of *Polytrichum* occur, and more than that number of species of *Sphagnum*, and the *Semisaprophytic Splachnum Sphæricum* with its enormous apophysis is frequent on the moors. The rather local *Atrichum crispum* occurs sparingly, and the presence of several species of *Rhacomitria* with *Oligotrichum hercynicum* serve to indicate the montane character of the district.

Many gemmiparous hepaticæ occur in plenty, such as *Kantia Trichomanis*, *Jungermannia intermedia*, *Scapania curta*, &c. If the nearest mountain limestone district be visited, many interesting species will be met with; *Lejeunia Rossetiana* with *Seligeria pusilla* (and various species of *Nostoc*) will be found on vertical shady rocks, often accompanied by the alga *Scytonema myochrous*. Accompanying these will be found such lichens as *Amphiloma lanuginosum*, *Lecidea cupularis*, &c. *Neckera crispa* fruits abundantly, and *Zygodon Nowellii* is found here and there on exposed walls, while *Pseudoleskea catenulata* is found both on walls and

rocks, and in one boggy place there is an abundance of *Cinclidium stygium*. Three species of *Andreaea* occur on grit rocks at about 2000 feet elevation, and the chinks of many of these rocks are filled with masses of the characteristic *Mylia Taylori*. *Mylia anomala* occurs on the moors with *Sphagnocœtis communis* and species of *Cephalozia*.

In the immediate neighbourhood lichens are almost absent, but about the woods and moors such frequent species as *Parmelia physodes*, *P. saxatilis*, *Platysma glaucum*, *Cetraria aculeata Umbilicaria polyphylla*, *Lecidea concentrica*, *L. contigua*, *Squamaria saxicola*, and several species of *Cladonia* still linger on. If one goes twenty miles or so to the north, many species become frequent. *Solorina saccata* is plentiful on soil among the mountain limestone rocks, the earthy crevices immediately above being filled with fine *Trichostomum mutabile*. Both rocks and walls are here most prolific in species, and any worker will find abundant material.

It would, of course, be possible to give long lists of names of species which may be found, but that is not the object of this notice, which is designed rather to indicate the nature of the district to those botanists who are visitors.

2.—GEOLOGY.

By J. E. WILSON.

The district described is included in the following maps of the Geological Survey on the scale of one inch to a mile.

Sheet 92 N.W. (New Series Sheet 60)
,, 92 N.E. (,, ,, 61)
,, 92 S.W. (,, ,, 68)
,, 92 S.E. (,, ,, 69)
,, 88 N.E. (,, ,, 77)

The following works may be consulted for more detailed information:

"The Geology of Yorkshire, part ii., The Mountain Limestone District," by Prof. John Phillips, 1836;

"West Yorkshire," by J. W. Davis and F. A. Lees;

"The Geology of the Yorkshire Coal Field."—Memoir of the Geological Survey by Prof. A. H. Green and others.

A Bibliography of books and papers relating to Yorkshire Geology up to 1876 is included in Davis and Lees' West Yorkshire. A more recent Bibliography, for the years 1884 to 1895 has been issued in the volumes of the *Naturalist* from 1885 to 1899. See also the volumes of the Proceedings of the Yorkshire Geological and Polytechnic Society.

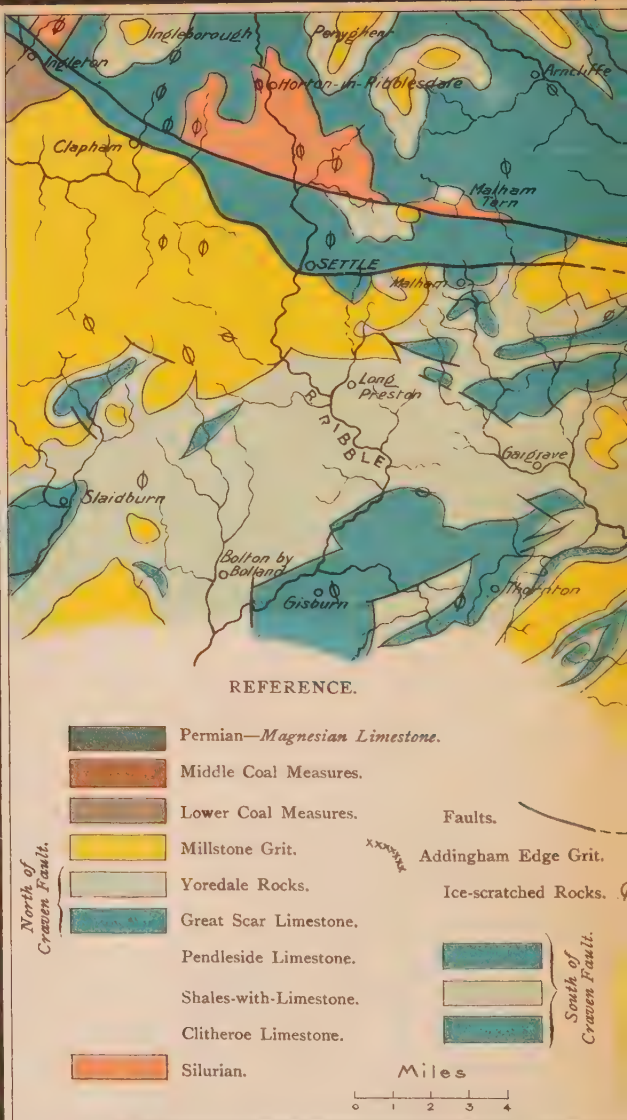
Physical Geography.—The city of Bradford lies in a basin drained by a tributary of the River Aire, and surrounded, except upon the outlet-side, by hills ranging from about 600 feet above the sea on the east, to 900 to 1200 feet on the west. The central part of the city is about 330 feet above the sea. The ridges which form the lip of the basin rise in height to the westward, and beyond the limits of the Bradford basin reach a height at Boulsworth Hill of 1700 feet above the sea. They present an outline formed of dip slopes and escarpments, the dip being on the whole in a south-easterly direction. The lip of the basin to the south forms part of the watershed between the drainage systems of the Aire and Calder; all the other hills surrounding the city are in the drainage area of the Aire.

The real sources of the River Aire are on the fells to the north of Malham, but with the exception of Gordale Beck, the streams, the water of which goes later to form the River Aire, disappear into the ground to reappear at some distance lower down. Their underground course is under investigation, and the results arrived at will be described in the Report of the Committee appointed by the British Association at Dover. A preliminary report by the Committee of the Yorkshire Geological and Polytechnic Society has been published. One of the larger streams is that flowing through Malham Tarn, a natural lake about half-a-mile square, of no greater depth anywhere than 14 feet, but of more than its original size and depth owing to the embankment made at its outlet. The stream flowing from it runs above ground for about half-a-mile, and then sinks in several places into the limestone. The water from this and other streams issues partly at the foot of the fine crag of Malham Cove, and partly at springs a mile and a quarter below, known as Aire Head. From this point the river is known as the Aire. Its course for some miles is through an undulating country, the hills of no great height above the river, indeed for some miles of its course the watershed between the Aire and the Ribble only ranges between 470 and 700 feet above the sea, the River Aire itself in the meantime falling from 450 to 400 feet above the sea. About Gargrave the river receives an important tributary from the north in Eshton Beck. After passing Skipton the conditions change and the river flows through a gap in the hills, Skipton Fell to the north-east, 1200 feet, and Carlton Fell to the south-west, 1274 feet, form the two sides of the gap. From this point to Leeds high hills bound the Aire Valley. The river in cutting through an escarpment, after a course through a lowland district, shows the not uncommon feature that it had received its initial direction before the evolution of the present surface contour. There are no tributaries of importance flowing into the Aire from the northern side during this

portion of its course, but from the south enter the considerable streams of the Glusburn, the Worth River, Harden Beck, and the Bradford Beck.

Geological Structure.—The geological structure of the district described above, is not, on the whole, of a complicated character. The rocks exposed range from the Silurian to the Middle Coal Measures. To the north of Malham Tarn the higher hills are capped by Millstone Grit, on the sides of the hills the Yoredale beds crop out, and their lower slopes and the plateau about Malham Tarn is occupied by the Mountain Limestone. A belt of Silurian runs across from east to west immediately south of Malham Tarn, and about half a mile south the Mountain Limestone is brought down against the Silurian by the north branch of the Craven Fault. The beds above the Silurian have a slight northerly dip, the Mountain Limestone lies unconformably upon the Silurian, and rests upon its upturned edges. The Mountain Limestone to the south of the North-Craven Fault also has a slight dip to the north, and almost its whole thickness is exposed here in the hill slopes and deep ravines. About half a mile below Malham Cove it is cut off by the Mid-Craven Fault. The Craven Faults have a downthrow to the south, and are the most important dislocations in the district. They begin some miles to the west of Ingleton, in the neighbourhood of which place the throw of the fault is about 3000ft. Between Clapham and Settle the two most important branches become more widely separated and then run roughly parallel to one another in an east and west direction. The northern branch probably dies out some distance east of Pateley Bridge. The throw of the faults about Malham is several hundred feet. The effect of the Craven faults upon the physical geography of the district is most striking.

To the north are the hills of Ingleborough, Penyghent, and Fountains Fell- the highest points of a bare, upland district, in which are found the fine limestone scars so



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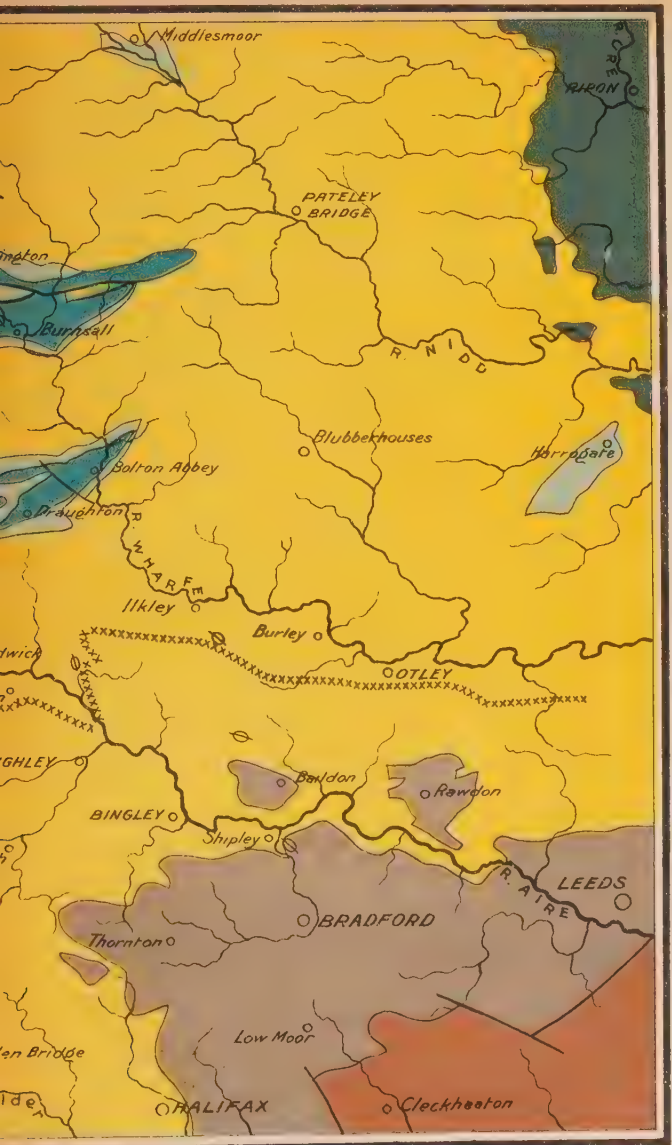

PART OF WEST YORKSHIRE.

W. Byles & Sons, Bradford.

characteristic of Upper Craven; for some miles to the south is a district much lower in altitude, much less striking in its scenery, but partly because of its different geological formation, it forms the rich grazing country for which Craven is famous. South of the Craven Faults the rocks of the lowland area between Malham and Skipton are thrown into folds, and three Anticlinals can be traced; the most strongly marked is the one passing through Skipton. The axis of the Anticlinals is in a direction nearly south-west and north-east, and is the local expression of the extensive Anticlinal folding, which, with a nearly east and west strike, separates the coal-fields of Lancashire and Yorkshire from those of Cumberland and Northumberland. Each Anticlinal brings up a patch of the Mountain Limestone, well seen in the Skipton Anticlinal in the large quarries of Skipton Rock, Hambleton Rock at Bolton Abbey station, and elsewhere. In the latter quarry, and also in the often illustrated example at Draughton, the subsidiary contortions which the rocks have undergone are well seen. South-east of Skipton the steep dip of the Anticlinal soon brings in the lowest members of the Millstone Grit series, and Skipton Fell exhibits the grits which are here the equivalents of the Kinderscout Grit. The folding of the Craven district now settles down into a more uniform and gentle dip to the south-east, the resultant of the east-and-west Anticlinal folding mentioned above and the folding of the great Pennine Anticlinal, which with its north and south axis separates the coalfields of Northumberland, Yorkshire, and Derbyshire on the east from those of Cumberland and Lancashire on the west, and which to the south brings the Mountain Limestone to the surface again in Derbyshire. The south-easterly dip causes beds higher in the series to appear in succession as one descends the Aire valley, and a great deal of the characteristic scenery of Airedale is due to the escarpments of various beds of grit. The highest bed of the Millstone Grit series, the Rough Rock,

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characteristic of Upper Craven; for some miles to the south is a district much lower in altitude, much less striking in its scenery, but partly because of its different geological formation, it forms the rich grazing country for which Craven is famous. South of the Craven Faults the rocks of the lowland area between Malham and Skipton are thrown into folds, and three Anticlinals can be traced; the most strongly marked is the one passing through Skipton. The axis of the Anticlinals is in a direction nearly south-west and north-east, and is the local expression of the extensive Anticlinal folding, which, with a nearly east and west strike, separates the coal-fields of Lancashire and Yorkshire from those of Cumberland and Northumberland. Each Anticlinal brings up a patch of the Mountain Limestone, well seen in the Skipton Anticlinal in the large quarries of Skipton Rock, Hambleton Rock at Bolton Abbey station, and elsewhere. In the latter quarry, and also in the often illustrated example at Draughton, the subsidiary contortions which the rocks have undergone are well seen. South-east of Skipton the steep dip of the Anticlinal soon brings in the lowest members of the Millstone Grit series, and Skipton Fell exhibits the grits which are here the equivalents of the Kinderscout Grit. The folding of the Craven district now settles down into a more uniform and gentle dip to the south-east, the resultant of the east-and-west Anticlinal folding mentioned above and the folding of the great Pennine Anticlinal, which with its north and south axis separates the coalfields of Northumberland, Yorkshire, and Derbyshire on the east from those of Cumberland and Lancashire on the west, and which to the south brings the Mountain Limestone to the surface again in Derbyshire. The south-easterly dip causes beds higher in the series to appear in succession as one descends the Aire valley, and a great deal of the characteristic scenery of Airedale is due to the escarpments of various beds of grit. The highest bed of the Millstone Grit series, the Rough Rock,

forms the higher parts of Rumbald's Moor to the north, and to the south Harden Moor and the extensive moors about the head of the Worth valley. The continued dip, aided by faults, brings the Rough Rock to the level of the river about Saltaire, and from here to Kirkstall it forms the floor of the valley.

The dip in the neighbourhood of Bradford becomes more southerly, so that the outcrop of the Lower Coal Measures, which about Halifax form a splendid escarpment facing westwards, and overlooking fine dip slopes of Rough Rock, trends in an easterly direction from the neighbourhood of Cullingworth, and runs to the south of, and roughly parallel to, the river Aire. The Lower Coal Measures have, however, a more northern extension in the outliers of Baildon Common and Rawdon.

The continuance of the same general dip brings in the Middle Coal Measures a few miles south-east of Bradford. The whole district is intersected by numerous faults, those most prominent in the Bradford area running roughly east and west, but none are of sufficient importance to seriously affect the general description of the lie of the rocks given above.

Silurian.—The lowest rocks in the district described above are found in the neighbourhood of Malham Tarn. The Upper Silurian, represented by members of the Coniston Grit and Flag series, forms a narrow band, cut off to the south by the North Craven Fault, which here runs nearly east and west, and brings down the overlying Mountain Limestone against it. A small exposure of these rocks in Gordale Beck shows them dipping at a steep angle to the southward. The exposure is so small that apart from the proof of the existence of the Upper Silurian in this locality, there is little of interest to record; but further to the westward, in Ribblesdale, Crummack Dale, and about Ingleton, is a most interesting district, first described by Prof. Phillips in 1829, later by Prof. McKenny Hughes,

but by no means thoroughly worked out even now. Malham Tarn owes its existence to its situation on the Silurians, the stream flowing from it, and other streams, at once sinking into the ground when they have crossed the Craven Fault, and so reach the fissured limestone area. Gordale Beck is an apparent exception, but even this stream, which, under ordinary circumstances, is continuous over the limestone, shows in a very dry season that some of its water is lost by sinking into the ground. An exposure of the Silurian at the foot of the gorge of Gordale Scar is said to have been once observed, but no one has since been able to verify this observation. All the same, the base of the limestone cannot be far below the surface at this point.

Carboniferous Limestone Series.—All the solid rocks exposed in the district under review, with the exception of the Silurian just described, belong to the Carboniferous system.

The most characteristic rock in the northern portion is the Great Scar or Mountain Limestone. It covers an extensive area in West Yorkshire, forms the plateaux and fine scars of Craven, and is the foundation upon which the hill masses of Ingleborough, Penyghent, Whernside, &c., are reared. In the district about the head of Airedale, to the north of the Craven Faults and in the area between them, the Mountain Limestone is found in its most typical form. It consists of a mass of calcareous beds from 400 to 800 feet thick, almost without division by shales or sandstones. The limestone is of exceptional purity and of a light grey colour. The presence of a fairly regular system of joints has given rise to a feature universal over the Mountain Limestone area. The solvent action of rain water has widened the joints and has so given rise to the fissured pavements which form the surface over a large part of the limestone portion of the Craven uplands. This limestone pavement may be easily and well seen at the top of the great scar of Malham Cove. A continuation of the same

solvent action in widening joints and bedding planes below the surface has caused the whole Mountain Limestone mass to be honeycombed by underground water courses. Those through which the head waters of the Aire find a channel have been referred to, but beyond this particular district much finer examples are to be found, and in the limestone plateaux about Ingleborough and Whernside are many extensive caves, often occupied by streams. The water of these streams has sunk into the ground at higher levels, and often disappears from view in openings in the limestone called "pot holes." Gaping Gill, on the slopes of Ingleborough, is a good example of a "pot hole," and the stream which flows into it re-appears below in the cave known as Clapham Cave. The great gorge of Gordale Scar appears to be largely due to the collapse of the roof of an extensive cave.

The base of the Mountain Limestone rests unconformably on the denuded surface of the Silurian. The lowest portion of the limestone is frequently a conglomerate, containing rounded fragments of the underlying rocks.

The upper portion of the Mountain Limestone in the district north of the Craven Faults becomes changed by the interpolation of beds of sandstone and shale. Further north these rapidly increase in importance, and we find the well-marked series of beds which in the neighbourhood of the River Yore or Ure have had the name of Yoredale conferred upon them. The Yoredale rocks consist of beds of gritstones and shales, with at least four well-marked limestones which persist over considerable areas. They are directly overlaid by the Millstone Grit series. But directly the Craven Faults are crossed in coming southward, the rocks underlying the Millstone Grit are found to have completely changed in character. The whole mass of rocks to the south is immensely thick in comparison to the rocks to the north of the faults; there is only one, or at the most two limestones that can be compared in importance to the limestones of the Yoredale series, and if the Clitheroe

limestone is regarded as the equivalent of the Scar limestone to the north, it is at least four times as thick. Mr. Tiddeman, who has worked out the Carboniferous rocks in this district, gives the following comparative table.*

Southern or Bowland Type.	Feet.		Feet.	Northern or Yoredale Type.
Millstone Grits.....	...		...	Millstone Grits.
Bowland Shales	300-1000	The Great Craven Faults.	400-900	Yoredale Series (Limestones, Grits and Shales).
Pendleside Grits ..... (inconstant)	0- 250			
Pendleside Limestone (with Knoll-Reefs)	0- 400			
Shales, with Limestones	2500		400-800	The Carboniferous Limestone (with Conglomerate at base).
Clitheroe Limestones (with Knoll-Reefs)	+ 3250 No base			

The peculiarity according to Mr. Tiddeman is that the northern type does not shade into the southern type, but that a sharp and sudden break occurs at the point where the Craven Faults cross, and that each type keeps its distinctive character right up to the faults. His theory of the cause of this is "that the Craven Faults were to a very considerable extent going on during the formation of the rocks, and that they are responsible for the lack of agreement between the two series which were being simultaneously deposited in the two adjacent areas." He finds that there are a greater number of beds which he regards as representing deep-water conditions on the down-throw side of the faults, and conversely more beds representing shallow-water conditions on the upthrow side. The character of the limestones is distinctly different. The northern type is a light-coloured limestone, the southern type black limestone. White limestones occur among those of the southern type, but only in patches, lenticular masses,

* Proceedings—Yorks. Geological & Polytechnic Society. Vol. XI., part iii.

which he calls Knoll-Reefs, rising into big mounds of conical form, which usually rest on the black limestones, and are crowded with fossils. The perfection of the fossils in these Knoll-Reefs is very wonderful, and our knowledge of the fauna of the Carboniferous Limestone period in this district is largely due to this fact. Mr. Tiddeman regards them as reefs formed in a similar way to Coral-Reefs. An example may be seen in the hill called Cawden, close to the village of Malham; but much finer Knoll-Reefs occur between the Aire and Wharfe valleys, between the villages of Cracoe and Burnsall.

Mr. Marr* differs from Mr. Tiddeman in his explanation of the difference between the rocks to the north and south of the Craven Faults. He regards the phenomena observed in the area to the south, as due to the extensive lateral pressure to which (as evidenced by the contorted strata at Draughton and elsewhere in the neighbourhood) the rocks have been subjected, and concludes from his observations that "the deposits which now occur on opposite sides of the fault may have been continuous, and generally similar in thickness, lithological conditions, and fossil contents: and the present differences would be due, as regards thickness, to repetition of strata on the south side, and as regards lithological characters and fossil contents, to changes in the characters of the rocks produced by orogenic movements acting subsequently to the deposition of the strata."

But whatever the explanation, the fact remains that the character and thickness of the rocks immediately to the north of the faults differ completely from that of the equivalent series immediately to the south.

Millstone Grit.—In the district under discussion the Millstone Grit series occupies the largest area of the surface. Most of the high hills in the Craven district,

*Quarterly Journal Geological Society, Vol. LV. (1899), page 327.

Ingleborough, and the rest, the high heather-clad moors between Airedale and Wharfedale, and round the head of the Worth valley are capped by grit rocks, and the valleys of the Aire from Skipton to near Leeds, and of its tributaries—the Glusburn, the Worth, and Harden Beck—are cut out of the mass of the Millstone Grit series.

The lowest member is the equivalent of the Kinderscout Grit of Derbyshire, and consists of massive beds of extremely coarse grit, containing pebbles of quartz in large numbers.

The division of the Millstone Grit series into second and third grits, which obtains in the Derbyshire area, cannot be satisfactorily carried out here. Between the Kinderscout and the upper bed of the Millstone Grit series is a great thickness of variable shales and sandstones. The most important and persistent bed of these "Middle Grits" in the Aire and Wharfe valleys is the grit known as the Grit of Earl Crag, near Steeton, or from its position in Wharfedale, the Addingham Edge Grit. It is usually a massive and coarse-grained rock.

Several beds of thin and inferior coal, mostly rather local in their distribution, have been worked in the Millstone Grits, showing the gradual change from the marine conditions of the Carboniferous Limestone period through the shallow water and estuarine Millstone Grits to the fresh water and terrestrial condition of the Middle Coal Measures.

The Rough Rock, a coarse grit, which persists with very little change over a large area, is the highest bed in the Millstone Grit series. It is extensively quarried, and yields stone of great value for purposes where a massive and durable stone is required, such as engine beds, harbour walls, and reservoir work. It is frequently used as a building stone, Kirkstall Abbey, for example, is built of Rough Rock. Its escarpments form striking features in the scenery of Airedale, as at the Druids' Altar near Bingley, Shipley Glen, Baildon Green, and elsewhere.

Its unyielding character has caused, especially in the

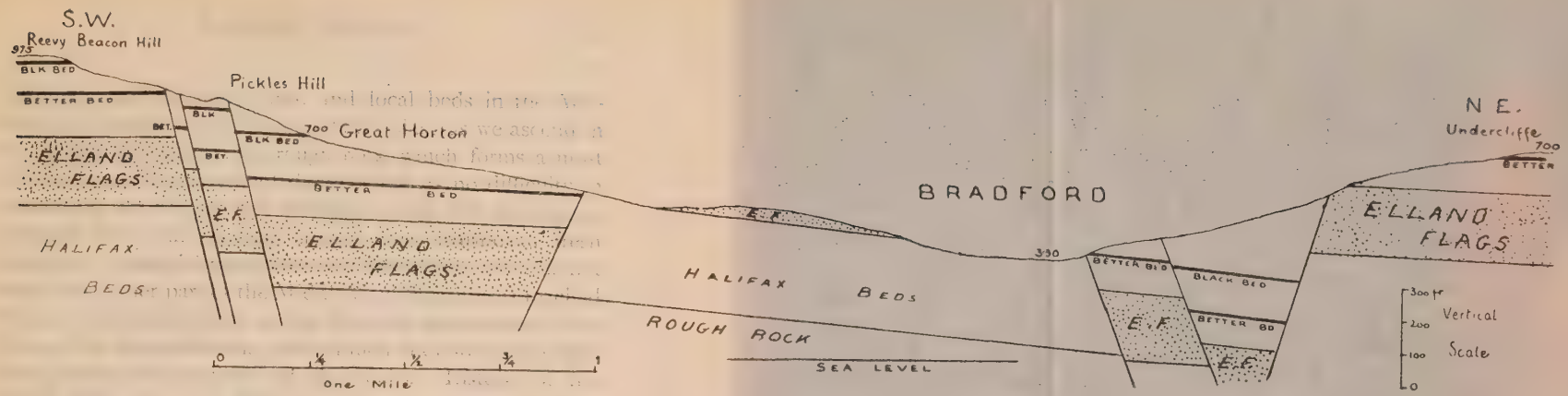
Halifax district, dip slopes, from which the escarpment of the Lower Coal Measures rises abruptly. At its base is frequently a flaggy bed, extensively quarried for flagstones and roofing slates.

In the City of Bradford a number of deep wells have been sunk, through the coal measures to the Rough rock, and in many cases a large supply of water is obtained, of a soft and pure character eminently well fitted for use in dyeing and for wool-washing.

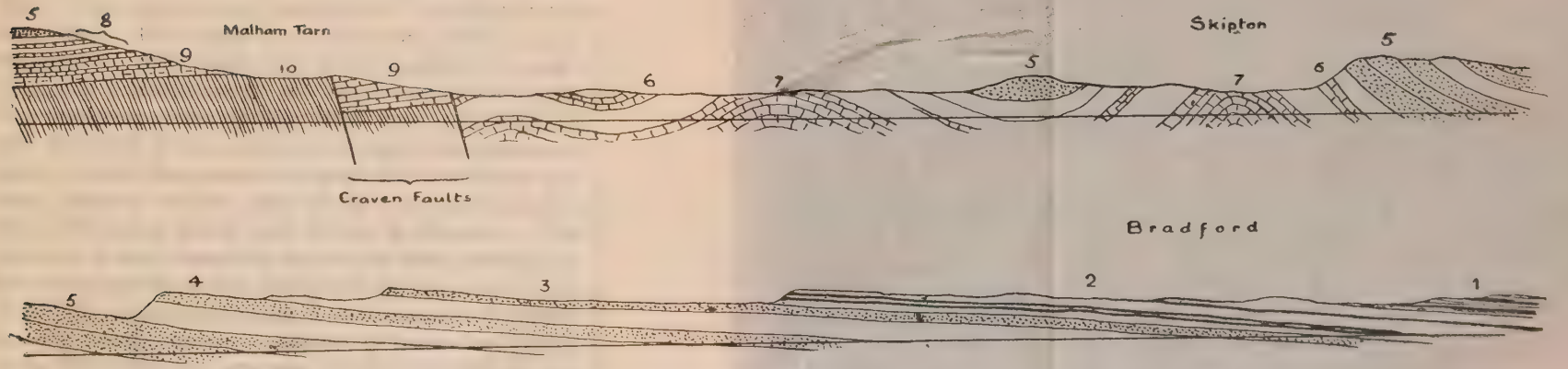
Coal Measures.—From an economic point of view the coal measures are the most important rocks of the area described. The City of Bradford owes a large part of its success as a manufacturing centre to its proximity to large supplies of coal, although in the immediate neighbourhood of the city the greater part of the coal has already been got.

The following is a summarised table of the rocks of the coal measures in this district, noting only the best known and most important of the coals worked.

		ft.	in.		ft.	in.
Middle Coal Measures	Haigh Moor Coal	2	11	to	4	0
	Coals, Measures, and Sandstones	672	0			
	Middleton Main Coal	0	6	,,	3	6
	Measures	60	0			
	Blocking Coal = Barcelona and Silkstone Coal	1	3	,,	2	4
Lower Coal Measures	Coals and Measures	167	0			
	Shertcliffe Coal	1	9	,,	2	10
	Coals, Measures, and Sandstones	196	0			
	Black Bed Coal	1	4	,,	3	0
	Measures	119	0			
	Better Bed Coal	1	0	,,	2	6
	Measures	10	0	,,	80	0
	Elland Flagstone	210	0	,,	130	0
	Coals, Measures, and Sandstones	300	0			
	Halifax Hard Bed Coal	2	3			
	Coals and Measures	90	0	..	48	0
	Halifax Soft Bed Coal	1	6			
	Measures	81	0	,,	147	0
	Rough Rock.					

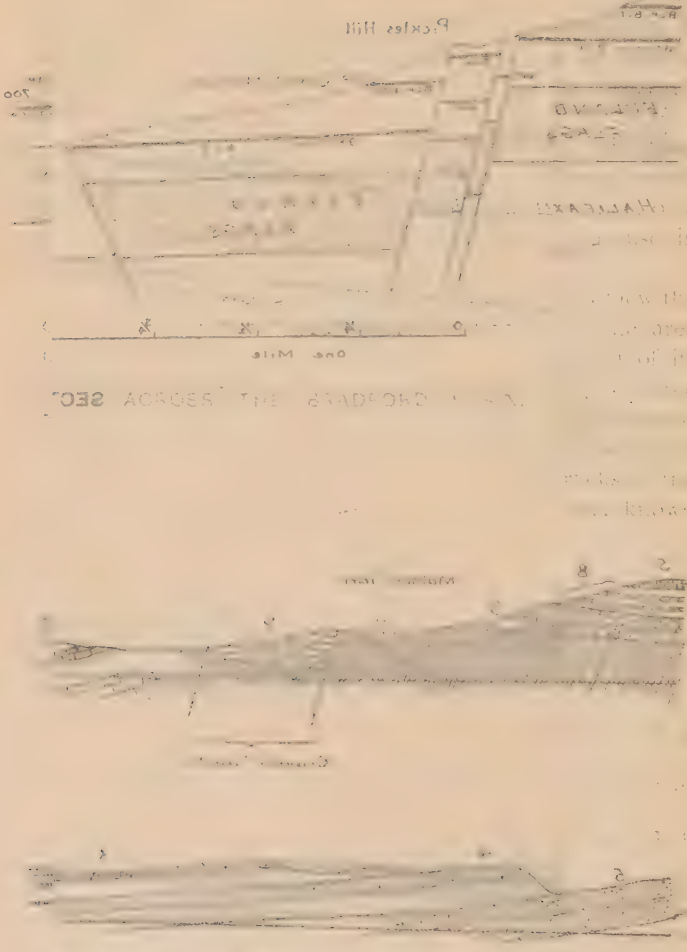


SECTION ACROSS THE BRADFORD BASIN.



DIAGRAMMATIC SECTION FROM FOUNTAINS FELL TO THE NEIGHBOURHOOD OF BRADFORD.

1 Middle Coal Measures
2 Lower Coal Measures
3 Rough Rock
4 Middle Grits
5 Kinderscout Grit
} Millstone Grit Series
6 Pendleside Limestone
7 Clitheroe Limestone
8 Yoredale Rocks
9 Great Scar or Mountain Limestone
10 Silurian


Pickles Hill
One Mile
1 Middle Coal Measures
2 Lower Coal Measures
3
4
5 Kinderscout Grit

Although coal occurs in thin and local beds in the Millstone Grit series, a rapid change takes place as we ascend in the series, and above the rough rock, which forms a most satisfactory and convenient datum, there is no difficulty in classifying the beds as coal measures. But with the accompanying rocks the gradual change from marine to fresh water and terrestrial conditions still continues, and it is not until the higher part of the Middle Coal Measures is reached that all incursions of the sea are found to have ceased. The change in the conditions under which they were deposited also affects the character of the rocks. Instead of the coarse gritstones of the Millstone Grit series, are fine grained and regularly bedded sandstones ; the intervening shales are also as a rule much finer in grain and less sandy than the shales of the series below.

The lower seams of coal are known, from their extensive outcrop in the neighbourhood of Halifax, as the Halifax Beds. The two principal seams are the Soft Bed and the Hard Bed. The former is a coal of fair quality, soft, and bituminous. The Hard Bed is an impure coal, and is frequently worked more for the seat earth than for the coal. The underclay of the Halifax Hard Bed, in common with that of several of the coals of the Lower Coal Measures, is partly a hard, fine-grained, compact, white, siliceous sandstone, crowded with the casts of the roots and rootlets of the coal-forming plants, and known as Ganister. When ground it is used extensively in iron and brass founding, and for making fire-bricks and for furnace linings. The portion of the seat earth, which is not of the character of Ganister, is also a valuable fireclay. Nodules of pyrites are frequent in the Hard Bed coal, and also rounded concretions called "coal balls," mainly composed of carbonate of lime, in which the most minute details of vegetable structure are preserved. A great deal of our knowledge of the internal structure of the plants of the coal measures is due to the study of the microscopic structure of the organisms

preserved in coal balls by the late Professor W. C. Williamson, Professor T. Hick, and others.

The shale immediately overlying the Hard Bed is in many localities full of fossils of marine genera, of which *Goniatites* and *Aviculopecten* are the most characteristic. Fish remains of the genera *Megalichthys* and *Cœlacanthus* also occur, a fine specimen of the former from this horizon is in the Leeds Philosophical Society's Museum.

From sixty to 100 yards above the Hard Bed is the Elland Flagstone, which caps all the hills in the neighbourhood of Bradford to the east, north, and west. It is extensively quarried wherever it occurs. Parts of it are an extremely valuable building stone, and the whole district in which it is found is characterised by stone-built buildings. It is to the Elland Flagstone that the solid and substantial appearance of the buildings in the City of Bradford is due. There is hardly a building of any kind, certainly none of importance, which is not built of stone. A brick building is an anomaly in Bradford. The flagstones obtained from this group of beds are of excellent quality, and are used for paving stones, landings, and roofing slates. The older buildings in this district are almost universally roofed with stone, and the roofs of this material are extremely durable. In a quarry in the Elland Flagstone at Clayton a group of Sigillaria *in situ* was found some years ago, and quite recently a single fine specimen. Specimens with the attached roots are preserved in the Owens College Museum, Manchester, and in several of the Bradford public parks. Similar groups of trees have been known to occur in other localities in the Elland Flagstone. Although the Elland Flagstone is the most important, other sandstones, higher in series, as the Oakenshaw Rock, contribute to the supply of building stone, and take its place in the district to the south of Bradford. Above the Elland Flagstone is the Better Bed coal, which, though of no great thickness, is very valuable, particularly for smelting purposes, owing to

its freedom from sulphur and other impurities. The excellence of the Bowling and Low Moor iron was largely due to the use of this coal. It is largely made up of the spores of Lycopodiaceous plants, and its structure is well seen in thin sections, under the microscope.

Forty yards or so above the Better Bed is the Black Bed coal, which has been chiefly worked as an engine coal. It is worked in conjunction with the ironstone-bearing shale immediately above it. The ore is not rich, containing from 28 to 29 per cent. of metallic iron, but from the extreme care taken in cleaning, calcining, and smelting it, as well as by the use of the Better Bed coal, as mentioned above, the iron obtained a world-wide reputation for good quality.

The only other bed of importance in the Lower Coal Measures is the Shertcliffe coal, one of a very variable series of coals, which further to the east forms part of the valuable Beeston Bed extensively worked in the neighbourhood of Leeds.

The Blocking coal has been taken by the Geological Surveyors as indicating the division between the Lower and the Middle Coal Measures, a division which is not marked by any striking change in the character of the beds, but made at this point for convenience.

As the Middle Coal Measures are characterised by thicker and more valuable coals than the Lower Coal Measures, and as the Blocking coal is the continuation in this district of the very important Silkstone coal of the Barnsley district, there is a good reason for fixing the dividing line below this coal.

The Blocking coal in this neighbourhood is, however, by no means so valuable a coal as further to the south. The Haigh Moor coal is extensively worked as a house coal. No special mention need be made of the other coals in this district.

Although only the most important coals have been

mentioned above, twenty seams have been recognised by the Geological Survey, between the Rough Rock and the Haigh Moor coal.

Glacial Beds. A large portion of the Aire valley and of its tributary valleys is covered by drift. In the district between Malham and Skipton are numerous mounds of drift. At Skipton, and at many places in the Aire valley and in the Bradford basin, notably in the neighbourhood of Bowling, true "till" is found, a stiff blue clay, effervescing with acid, and containing scratched boulders. The boulders appear, with the doubtful exception of a single boulder of granite recorded by the Geological Surveyors at Bowling, to be of rocks, none of which have an origin outside West Yorkshire. In the Bradford till, limestone is plentiful, and it is possible that some of the boulders may have come from the Settle district, but this is by no means certain. On the eastern side of the ridge which bounds the Bradford basin on the east, a stiff, tenacious clay occurs, very similar in its general appearance to that within the Bradford area, but differing in that the included boulders are all of local origin, limestone is exceptional, and the clay itself does not effervesce with acid.

Ice-scratched surfaces have been observed in several places in the Aire valley, indicating the course of the glacier which came down Airedale. It is possible that the mounds of water-worn gravel and sand which occur in the Aire valley between Keighley and Bingley and below Shipley are the remains of the terminal moraines of this glacier. At Bingley the mounds more or less fill the bottom of the valley, and the thickness of the gravel is over 100 ft. The river was dammed up by these deposits, and there is evidence of the existence of a lake, which occupied the valley above the barrier. The river cut a new channel for itself to the southward. A similar case occurs between Bingley and Saltaire, where the river takes a sharp bend to the northward and has cut a new channel

through the solid sandstone some distance north of its old position.

The late Prof. H. Carvill Lewis noted* that the effect of a glacier filling the Aire valley would be to dam up the waters of its tributaries, and form lakes. He mentioned three, a lake eastward from Skipton towards Bolton Abbey, a lake filling the Worth valley, and one filling the Bradford basin. Recent observations have verified Prof. Lewis' acute inferences, and the notches in the ridges separating each of the chain of lakes to the south of the main Aire valley, and the outlets of Lake "Bradford" into the drainage areas immediately to the east and south, have been noted. Deposits which appear to be delta formations in these lakes have also been observed.

Cave Deposits.—Although so large a portion of the district under review is occupied by limestone, no bone-caves have been discovered. The well-known Victoria Cave lies in the drainage area of the Ribble, though not far removed from Airedale; and in Wharfedale, Dowkerbottom Cave, near Arncliffe; and Elbolton, a cave in one of the largest of Mr. Tiddeman's Knoll-reefs, have yielded animal, and the latter, human remains. During quarrying operations at Raygill, in Lothersdale, a few miles south of Skipton, a fissure was discovered, filled with earth and clay containing a very interesting collection of remains.† They included bones, &c., of hyena, hippopotamus, elephant, *Rhinoceros leptorhinus*, and *Felis spelæa*.

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* British Association, Manchester, 1887, also "Glacial Geology of Great Britain and Ireland." p. 63.

† Proc. Yorks. Geol. & Poly. Society, Vol. vii., part iii., p. 300.

3.—POND LIFE.

By WILLIAM WEST, F.L.S.

Ponds and pools by no means abound in the neighbourhood of Bradford, and there is therefore not much opportunity for the study of the aquatic fauna and flora. But the student who uses the microscope legitimately—that is, as a tool for the investigation of those organisms which otherwise would have to remain unknown—will find plenty of material to work at, even if ponds are not frequent. He will find organisms in plenty such as *Chlamydomonas*, *Haematococcus*, *Gonium*, and *Pandorina*, and if he cannot satisfy himself as to whether they are plants or animals, he should by all means announce that he will open a discussion at a joint meeting of the zoological and botanical sections as to their animal or vegetable nature with the almost inevitable result that after a couple of hours' enlightenment from various sages, he will be more in doubt than ever.

There are, however, still left numerous undoubted minute aquatic plants and animals, the great majority of which—if not all—are without doubt not confined to this district. These range from unicellular organisms like *Arcella*, *Centropyxis*, and *Actinophrys* up to *Rotifera*, and small *Oligochaeta*. Further up the scale the *Tardigrada* and abundance of transparent insect larvæ abound. There are also plenty of Entomostraeæ and water-mites. Algæ occur in plenty, ranging from numerous unicellular species of many genera up to several species of Florideæ.

4.—MAMMALIA.

By F. RHODES.

The Zoology of Airedale has been somewhat neglected, although the Bradford naturalists have been particular to

note all authentic records. The bats are represented by the long-eared bat, which occurs in Bingley Woods and about Seven Arches, and specimens can sometimes be obtained from beneath the aqueduct in the stonework. Vesperugo pipistrellus may be seen flying about the church at Eccleshill and at Esholt. The reddish-grey bat, *V. nattereri*, has been taken from the belfry of Bingley Church. The common and the water shrew are well distributed throughout the valley. The same may be said of the hedgehog and the mole. Cream-coloured varieties of the latter have been taken at Fagley.

Of the Carnivora, the otter is the rarest, though it has been seen as low down the river as the late Mr. Henry Mason's house at Bingley. The fox was known to breed in Fagley Woods about 1889, when several young ones were killed and set up by local taxidermists. The stoat and weasel are both common throughout the district, but the former seldom if ever gets into true winter dress. Of the badger there are no recent records, though it has occurred so near as Bolton Woods in Wharfedale.

The Rodentia are well represented. The squirrel is in almost all the woods of any size. The dormouse is recorded somewhat doubtfully to have been seen at the edges of Calverley and Fagley Woods. The field mouse is very well distributed, and the brown rat and common mouse are of course general. The water vole can be seen all along the river and canal banks, and some very beautiful dark varieties occur. The common field vole is common in the farming districts, and the red field vole or bank vole is to be met with on the railway embankment along the valley about Calverley, Apperley Bridge, and Bingley. The hare and rabbit are fairly common in the upper part of the valley and on the moors.

5.—BIRDS.

By E. P. BUTTERFIELD.

The district to which the following notes have reference, viz., the drainage area of the river Aire, together with its tributaries from Malham Tarn to Apperley Bridge, is for the variety and richness of its physical features perhaps unequalled in England. Not the least interesting feature is its great altitudinal range which at Malham Tarn attains 1250 feet, whilst at Apperley Bridge only 168, and as might reasonably be expected the district is favourable to the occurrence of a variety of birds, though it must be confessed that many of the warblers do not occur in great numbers, owing perhaps, to some extent, to the scanty undergrowth in the woods. It is not to be pretended that all error is eliminated, as very little is known of the Avifauna of the upper Aire valley, and especially is it to be regretted that so little is known regarding Malham district, "realm of mountain and fell, beautifully lone." On the other hand the Bradford District proper has received a considerable share of attention from local ornithologists, and it is not very probable that much fuller information will be brought to light by future investigations, particularly respecting the truly indigenous species.

We could have wished that there had been some information at hand of an authentic kind regarding the distribution of birds in this part of the Aire valley at a former period, for comparison with the present list, as such material would have been interesting from many points of view. It is certain that within the present generation many changes have been observable in the bird fauna. One species, viz. the hawfinch, was almost entirely unknown formerly, but of late years has been gradually increasing in numbers, and the stockdove is much more common than in former years; on the contrary a few species seem to have become scarcer, the

most marked of which perhaps are the twite and common linnet, the partial disappearance of whin covers may however account for the scarcity of the latter species.

The whole subject, however, of the distribution of birds is a very interesting study, and cannot be explained, so we think, as was formerly surmised, solely in correlation with a sufficient food supply. The stonechat and chiffchaff are so rare in this district as never to have come under our observation as breeding species, and the pied flycatcher, which breeds in some parts of Wharfedale in such numbers as probably in no other part of Britain, very rarely breeds here, and it is hardly conceivable that its absence is owing altogether to lack of suitable food.

The district may be said roughly to be equidistant from the eastern and western sea-board, and this may account for the paucity of marine species in the following list. A good many species of sea-birds pass over the district at certain seasons of the year, frequently alighting for a short stay at the few sheets of water, but as these are in many cases at inconvenient distances from points of observation, the species are rarely identified.

It has been thought preferable to give short notes of the most characteristic birds rather than a complete list, as the present handbook is not a suitable place in which to put on record all the birds of the district, many of which are of course, of wide-spread distribution.

Of the RESIDENT birds the song thrush has been more abundant during the year 1899 than has ever been known in previous years. In 1880 and for some subsequent years it was very scarce. The golden-crested wren is numerous in winter, and a few remain to breed. The dipper is not at all a scarce bird about our hill streams, and is common about Malham. One specimen of the crested titmouse (*Parus cristatus*) is said to have been shot on Thornton Moor, near Haworth. The meadow pipit (*Anthus pratensis*) is abundant on the moors in summer; much scarcer in

winter throughout the whole district. The goldfinch is said to have nested here formerly ; if so, it is now only an occasional winter visitor. The tree sparrow (*Passer montanus*) is a local resident, but only two or three habitats are known in the whole district. One of the commonest, perhaps the most common, resident bird in our woods in summer is the chaffinch. The females nearly all leave in winter. The linnet does not breed as commonly as formerly ; it is scarcely ever seen in winter. Its scarcity is not due to bird-catchers, as there are not so many as there used to be. The twite formerly bred in some numbers on the moors, but has been much less common of late years. The bullfinch breeds very sparingly in the district. The corn bunting (*Emberiza miliaria*) is somewhat local, but by no means scarce in summer ; it is, however, rare in the winter. It is interesting that the starling, though numerous, occurs in much greater numbers in some years than others, frequently leaving certain breeding habitats without apparent cause. The jay is rare ; it is certainly much more scarce than formerly, and seems to shun the vicinity of great manufacturing centres. It is somewhat strange that, in face of much persecution, the magpie holds its ground, and is fairly common. This also applies to the jackdaw. The raven has not been yet recorded in Airedale ; it may breed occasionally at the head of the valley, but is fast disappearing as a breeding species in Yorkshire. The carrion crow is found in very limited numbers ; it undoubtedly breeds in the upper portion of Airedale, but has not been known to breed in the lower part of the valley.

Perhaps the most abundant resident found in fields is the skylark. It partially migrates in winter, and in severe winters nearly all leave. The wood lark (*Alauda arborea*) is recorded near Bradford more than twenty years ago ; whether breeding or not is not stated. The record, if confirmed, would be interesting. The tree pipit (*Anthus trivialis*) is here sometimes called wood lark.

The green woodpecker is scarcer than formerly, and never has been common anywhere in the Aire valley above Apperley Bridge. The great spotted woodpecker is a much more common species. Only one example (at Bingley) of the lesser spotted woodpecker has been recorded. The kingfisher is generally, but not very commonly, distributed, and it is surprising how it maintains its ground in spite of the persecution to which it is subjected. Great numbers are to be seen amongst the specimens preserved by our local collectors. The owls are not numerous. Of the Falconidæ the sparrow hawk is perhaps the most common, though the kestrel is the most frequent in early autumn.

The ringdove is common. In autumn, sometimes vast flocks are seen, no doubt immigrants, which sometimes, as during the winter of 1899-1900, remain through the winter, and feed upon acorns. The stockdove was formerly quite scarce, but has been increasing in numbers for some years. The red grouse is common on the moors ; the partridge is much less common than formerly when grain was more generally cultivated. The red-legged partridge (*Caccabis rufa*) has occasionally been obtained. We are not aware that any attempt has been made to introduce it into this district, though it seems to have become fairly acclimatised in England.

The coot is not at all common in the vicinity of Bradford, but breeds at Malham Tarn. The ringed plover is of very occasional occurrence. The woodcock occurs in very limited numbers ; it has undoubtedly bred above Keighley, and there is every evidence of its increasing its breeding range in Yorkshire. Only one habitat is known where the dunlin breeds in limited numbers, and we fear it will ultimately be exterminated, as it is easily caught by being driven into nets in the breeding season. It is to be hoped by all genuine naturalists that this process of extermination of one of our most interesting birds will be put a stop to.

The common curlew breeds not uncommonly on the high moorlands, but is rather local. It seems to prefer those areas covered by *Nardus* (mat grass). The black-headed gull is said to have bred near Bingley, where it occurs in some numbers in the Spring, but its nesting we think rests on insufficient evidence. Mr. Ellison, of Steeton, however, is very positive as to its breeding near Kildwick; if so, it is a very interesting record.

Of the SUMMER VISITANTS the stone-chat has never been known to breed in this district. It has been known to breed formerly at Steeton, but very rarely, and has not done so of late years. Its absence or extreme scarcity as a breeding species is very remarkable, especially when taken in connection with its alleged habits. A black redstart was recorded at Bingley in 1877. One record exists of the occurrence of the nightingale near Shipley, but this is not properly authenticated, as frequently reports come to hand of its occurrence in the neighbourhood, but the bird invariably turns out to be the sedge warbler. Only two instances are known of the lesser whitethroat breeding. The most numerous summer migrant which visits our woods is the willow wren. The reed warbler is uncommon, and we fear is fast disappearing. One specimen of the crested titmouse is recorded. The spotted flycatcher has been more common than usual during the present year. The pied flycatcher is rare. As mentioned above, it is somewhat strange that this species should breed plentifully in Bolton Woods and yet so rarely in Airedale. The swift is rather local; it is not at all common in the neighbourhood of the great centres of industry, though it is plentiful at Skipton. The night-jar is the latest to appear in this district; it is rather local in its distribution, but is not at all uncommon on the slopes of some of the moors. The cuckoo is more common on the moors than in the woods. In this district it lays its eggs more commonly in the nest of the tit-lark than in those of all the other species of birds put

together. Next in frequency is that of the whinchat. It very seldom lays its eggs in the nest of the hedge sparrow in this district.

Among the WINTER VISITANTS the redwing, fieldfare, and snow bunting vary very much in their frequency in different years. The great grey shrike is scarce. The waxwing, siskin, bramling, mealy redpoll, and crossbill are occasional winter visitors. The hooded crow is scarce, so also is the short-eared owl. The common buzzard and the rough-legged buzzard are both much less frequently seen than formerly. The honey buzzard has been shot in the district. The peregrine falcon is occasionally met with in autumn and winter. The teal is of frequent occurrence, and breeds sparingly at Malham Tarn. The widgeon is rare. The golden eye is an occasional visitant ; of the common scoter (*Ædemia nigra*) only one record is known. The spotted crake (*Porzana maruetta*) is of uncommon occurrence, although not known to breed, it has been shot somewhat late in spring. The water rail is not at all common, but much more so than the preceding. A specimen of the little bustard (*Otis tetrax*) has been recorded near Bradford many years ago. The grey plover is rare, so also is the wood sandpiper. The little auk, the divers, and the red-necked grebe are visitors of very uncommon occurrence. One record exists of the stormy petrel ; a solitary specimen was picked up dead at Bingley.

A few birds of casual or accidental occurrence have been recorded, among them the golden oriole, the roller, the hoopoe, the eagle owl, which, however, may have been an escape from confinement, the hobby, cormorant, bean goose and the bernacle goose, the greenshank and the grey crested grebe.

Altogether about 153 birds have been recorded in the district.

6.—FISHES.

By F. RHODES.

The perch is fairly common in the River Aire and the Leeds and Liverpool Canal. It is also found in Malham Tarn, at an elevation of 1250 feet. The specimens caught in the Tarn are sometimes blind, this, it is said, being probably due to the altitude. The ruff or tommy bar (*acerina cernua*) also occurs in the river and canal. The river bullhead is very plentiful about Seven Arches, Bingley, in most of the shallow places higher up the river, and in the Tarn at Malham. Only the three-spined stickleback occurs in upper Airedale; the ten-spined stickleback is recorded for Leeds, but as yet it has not been found higher up the valley. The gudgeon, roach, chub, and dace are all to be found in the river and canal. The minnow occurs in the river and at the Tarn. The loach or "tommy loich," as it is locally known, is common in Peel Park Lakes, the canal, and Malham Tarn. The pike is taken in the River Aire, but is by no means a common fish. The same may be said of the eel; probably the polluted condition of the lower part of the river may account for this. Trout are fairly common in the streams and the Aire, where they are protected by various Angling Associations. A few are occasionally taken in the canal. At Tong Park, Esholt, a few are to be seen which are probably the remains of the old stock which were isolated by the pollutions of the river. A very superior trout is found in Malham Tarn. These possess a remarkable malformation, about one in fifteen having a deficiency in the gill coverings. Several anglers state that the grayling is still taken in the River Aire, although Messrs. Clark and Roebuck, in their hand-book of Yorkshire Vertebrata, give it as extinct since 1824.

7.—REPTILES AND AMPHIBIANS.

By F. RHODES.

Reptiles and amphibians are not very numerous. The common grass snake has been recorded several times. A fine specimen was picked up at Crossley Hall, near Allerton, in April, 1898, but it is a very rare occurrence in the district. The common lizard is to be found on the railway embankments about Apperley Bridge, Bingley, Keighley, and higher up the line; also on Rumbald's Moor and Shipley Glen. The slow worm (*anguis fragilis*) is not yet recorded for Airedale, though it ought to occur in the higher parts of the valley about Skipton, Bell Busk or Malham, as it is very common just over the hills in the Wharfe valley about Bolton Woods and Appletreewick. The amphibia are not so plentiful as in some districts for want of ponds and ditches. The large-crested newt is the most common: it occurs in the ponds on Rumbald's Moor and Bingley; also in the old river bed at Utley. The smooth newt is found associated with it in the ponds in the valley. The palmated newt has not yet been found higher up the valley than Leeds; it is recorded for Ilkley in the Wharfe valley. The toad is fairly common throughout the district, as naturally is the common frog. The natter jack toad and edible frog however, are still wanting.

8.—ENTOMOLOGY.

By J. W. CARTER, M.E.S.

Previous to the formation of the Bradford Naturalists' Society, in 1875, the insect fauna of the district, including the whole of the Aire valley from its source to the city boundary of Leeds, was very little known; indeed it may

be said that entomologically, up to that time, it was purely virgin ground.

From 1875 onwards a fair amount of original work was done, but it was not until the year 1880 that a thorough systematic investigation was begun. In the year named the area of research worked by the society was extended, and its limits defined, and recorders appointed, whose duty it was to prepare exact reports of the work annually done. The area thus set apart included (1) the drainages of the Aire from its source to the city boundary of Leeds; (2) the Wharfe from its source to its junction with the Washburn, near Otley; (3) the Ribble, from its source to the Lancashire border; and (4) the Yorkshire portion of the Lune. Beyond odd notes of rare occurrences in the *Naturalist* and other periodicals, no lists of the insect fauna have been separately published, but those of the Lepidoptera (butterflies and moths) were incorporated in the "Lepidoptera of Yorkshire," by Geo. T. Porritt, F.L.S., F.E.S., &c., published in 1883, as "Transactions of the Yorkshire Naturalists' Union." In this book, over the initials of the present writer and those of Mr. E. P. Butterfield as guarantors, a full list of species known up to that time may be gleaned. The district for a few miles around Bradford is not prolific in insect life, they do not thrust themselves upon one's notice even in the most likely districts, and the student who would be successful must exercise an amount of diligence and dogged perseverance that would astonish a collector who had been accustomed to the "sunny south."

The class Insecta, as a whole, has had but few enthusiastic devotees; the result is that comparatively little is known except of the more popular orders Lepidoptera (butterflies and moths) and Coleoptera (beetles); the former having received the lion's share of attention.

Lepidoptera.—Of this order some 500 and odd species

are recorded for the area detailed above, yet, with very few exceptions, the whole of them occur in the valley and drainages of the Aire; the number known for the whole of Yorkshire is about 1350; while for Britain a little over 2000 species are recorded.

For butterflies (*Rhopalocera*) we should fancy that it would be difficult to find a more barren hunting ground than the district under consideration; miles upon miles may be traversed by the wandering naturalist, and not one of these sun-loving creatures, which give such animated beauty to any landscape, may be seen. And this is characteristic of many parts of the West Riding of Yorkshire.

Not more than twenty species have been recorded for the whole area, whilst not more than a dozen may be depended on to occur regularly. *Pieris brassicæ*, *P. rapæ*, *P. napi*, *Cœnonympha pamphilus*, and *Vanessa urticæ*, are all that may be considered common and generally distributed; *C. pamphilus*, however, is almost restricted in its range to the extensive ling-covered moorland, which constitutes a considerable area of the district. The gorgeous Red Admiral (*Vanessa atalanta*) is sometimes very abundant, as in 1899, at other seasons scarcely an example is seen; the Painted Lady (*V. Cardui*) is very spasmodic in its appearances; the visits of the Camberwell Beauty (*V. Antiopa*) are few and far between; while the wandering Clouded Yellow (*Colias edusa*) has not been seen in the district since the great "Edusa year" (1877)—when this species occurred throughout Britain, and twenty five specimens were captured in this district, including one of the variety Helice. Specimens were then taken at Low Moor, of coal and iron-furnace fame, the most unlikely place in the world for these "Children of the Sun." The Green Hairstreak (*Thecla rubi*) has only been recorded for Wharfedale, and in the same river basin at Grassington the northern species *Erebia blandina* is extremely abundant, but remarkably local: this station is probably the southern

limit of its distribution in Britain. *Lycæna agestis* is another species found in Wharfedale which has not yet been recorded for the Aire Valley.

Characteristic Insects of the Moors.—Certain insects are as characteristic of our moorlands as the favourite wiry-stemmed ling (*Calluna vulgaris*) which stretches over and almost monopolises a considerable area of the region under consideration. Amongst these, special mention may be made of the beautiful Emperor Moth (*Saturnia Carpini*), which is to be found in great numbers in the month of May. The curious phenomenon of "assembling," so characteristic of the Bombycidæ, is here as highly developed as in any species of the group, and has often excited the wonder and admiration of people who are not conversant with the many strange truths in the lives of those much despised creatures—insects, and, in fact, has often been the means of leading eye-witnesses to a higher appreciation of them. The big, green, variously-spotted caterpillar, when seen fully extended, and exposed on the tops of the plants of ling, is one of the most beautiful of our native species. Another species not less common is the Eggar Moth (*Bombyx quercus var: Callunæ*), with wings of rich mahogany brown; whilst the little Heath Moth (*Fidonia atomaria*) is incessantly flitting over the heath from flower to flower, together with the Heath Butterfly (*C. pamphilus*), and now and again the lovely, brightly-coloured Beautiful Yellow Underwing (*Anarta myrtilli*) darts across the scene. The rare *Stilbia anomala* is locally common, and is perhaps nowhere else in the county obtainable, whilst over the patches of Cotton-grass (*Eriophorum*) the pretty *Celæna Haworthii* sometimes swarms in the afternoon sunshine, and *Scodionia belgiaria* is always to be found in its season.

All those enumerated may be found in their respective seasons, but it is not by any means an exhaustive list of our moorland Lepidoptera; it includes only those which are really characteristic—those species which are to the

entomologist as much a constituent of the moors as the ling is to the botanist.

Local Species.—Of the rarer or more local species of the district may be mentioned *Geometra papilionaria*, *Eupisteria hepararia*, *Venusia cambricaria*, which has sometimes swarmed about the mountain ash, and *Acidalia fumata*. The whole of the genus *Hybernia* are exceptionally abundant, *defoliaria* occurring in every conceivable form from very pale to almost black, while *Cheimatobia boreata*, another of the winter species, is found occasionally in excessive numbers in birch woods. Of the genus *Larentia* all the species occur, and *Emmelesia affinitata* is locally common. *Acronycta menyanthidis* is occasionally common on our moorlands. *Charæas graminis* sometimes swarms, but not in such numbers as to cause any serious depredation in grass crops, while the rare *Miana captiuncula* finds a suitable habitat in Grass Wood at Grassington. Of the genus *Agrotis*, *agathina* has been found on the moors, *porphyrea* and *lucernea* in similar situation; the former is a regular constituent of our moorland insect fauna. The genus *Noctua* furnishes many species, *N. Dahlii* being the rarest and most interesting; it sometimes swarms on Ragwort flowers towards autumn. *Tæniocampa* is represented by five species; *Orthosia* has the full complement, and the rarest species of the genus—*suspecta*—is sometimes found in immense numbers. Many other species of interest are to be found, but the limited space at our disposal prevents a further enumeration of them.

Variation.—Of late years the variation of species has been a subject of great interest and many interesting observations have been made, and the evidence which has been forthcoming points conclusively in one direction, viz., that the tendency in this district is undoubtedly towards *Melanism.* The best known example is *Amphidasis betularia* (locally known as the Pepper Moth), a species with, normally, a grey or whitish ground, peppered over

with brown or black. A quarter of a century ago the type form was frequently found, but of late years an intensely black form has predominated; it has been a case of visible evolution.

Phigalia pilosaria.—Even more rapid still has been the change in this species. Previous to 1880 a dark unicolourous olive-green form was of frequent occurrence, but in that year examples sooty black in colour were met with, a form which has annually increased in numbers. Whether it is as common far away from manufacturing districts is not known. This tendency to Melanism is well marked in many species, notably *Arctia fuliginosa*, *O. bidentata*, *Hybernia progemmaria*, *Ypsipetes elutata*, *Polia chi*, and many others.

Periodic Appearances.—It is well known to entomologists that occasionally some one species or other occur in enormous and altogether abnormal numbers, their sudden appearance often being wholly unaccountable. Amongst such which have been noticed in this district may be mentioned *Vanessa atalanta*, *V. Cardui*, *Pieris brassicæ*, *Plusia gamma*, *Triphæna pronuba*, *Noctua Dahlii*, *Orthosia suspecta*, *&c.*

Many species, on account probably of the alteration in the physical appearances, clearance of woods, &c., in the district, which were formerly abundant are now altogether absent or extremely rare, while other species which were formerly rare or absent have made their appearance. The most noteworthy in the latter category is *Cloantha solidaginis*. In 1896 this species turned up in goodly numbers in a district which had been minutely examined week after week for more than twenty years and not a single individual seen. In this case there had been no conceivable alteration in the district, the circumstance was totally unaccountable, one of those remarkable phenomena which gives such an impetus to the study of nature.

Coleoptera.—Next to the Lepidoptera, this is the most popular order in the class Insecta, and when the district has

been thoroughly worked it will be found to be fairly rich in land species. Owing to the comparative absence of ponds aquatic species are not abundant. The *Geodephaga* or ground species have received the greater share of attention, and some interesting species have been noted. Foremost amongst these may be mentioned *Carabus nitens*, one of the most, if not the most, beautiful of British species, which is of frequent occurrence on our moors ; *Miscodera arctica*, a lingering relic of a sub-alpine fauna, is found in limited numbers ; and *Pterostictus vitreus*, which is fairly common at high elevation. The tiger-beetles are represented by one species—*Cicindela campestris*. Of the genus Carabus, in addition to nitens, we have six species, including *C. arvensis*, which is only found in one or two other parts of the county. Of this group—Geodephaga—about one-third of the whole British species have been recorded for the district, the greater number of which are lovers of somewhat high altitudes, but the space at our disposal will not permit of a further enumeration of them. The same may be said of other groups of beetles. Many interesting species find suitable habitats on the high moors and escarpments characteristic of the district, and offer many interesting problems of distribution, variation, and other phases of insect life for solution by the student who is devoted to these too much despised creatures, yet withal perhaps the most interesting in the whole domain of nature.

Of the remaining orders comparatively little is known as yet, but it is hoped that ere long students will be forthcoming, and that the visit of the British Association to this city will give new zest to its citizens, and that a thorough investigation into the faunal constituents of the surrounding district will be the result.

The order Diptera, or two-winged flies, has recently lost an enthusiastic and devoted student by the death of Dr. R. H. Meade, who was one of the greatest authorities in Britain upon this order, and it is much regretted that

the results of his investigations cannot be incorporated in this article.

Some interesting but perhaps unwelcome insect guests from foreign shores have found a suitable home and habitation in the heart of the city, and have so increased and multiplied that they are found in workshops, &c., in vast numbers. The most noticeable of these are two species of Cockroach, *Phyllodromia germanica*, sometimes known as the "Croton Bug," and *Periplaneta Americana*. The former is said to have been imported into this country by the soldiers returning from the Crimea in 1857, and has since spread with trade and become established in some of our English cities and towns. The latter is an introduction from South America—a much larger species than the former—and doubtless brought into this city with logwood, which is largely used in dyehouses. Did space permit many other insects of great interest might be cited, but probably sufficient has been said to show that even an intensely busy manufacturing district is not altogether devoid of natural wealth and beauty.

9.—MOLLUSCA.

By F. RHODES, M.C.S.

A very complete list of the Airedale mollusca was published in the *Naturalist* for March, 1888, compiled by Messrs. J. W. Carter and H. T. Soppitt, to which only two species have been added, *e.g.*, *Arion minima* and *Testecella haliotidea*. Owing to the comparative absence of ponds and dykes several species of aquatic molluscs are absent, *e.g.*, *Physa fontinalis* and *Valvata cristata*. The three species of *Sphærium* are fairly common, *corneum* and *rivicola*, with several interesting varieties, in the river and canal. *S. lacustris* is common in the few ponds in the district. *Pisidium*

amnicum is very local in the river and canal and at Malham Tarn, *P. fontinalis* of varieties is common and very generally distributed, as also is *P. pusillum*. *P. nitidum* is only recorded from Bingley. Unionidæ is represented in Airedale by *Unio tumidus*, in the River Aire at Steeton and canal at Bingley. *U. pictorum* is also found in the river at Steeton, and probably in the canal, as dead shells have been found in the dredgings. *Anodonta cygnea* is common in suitable localities. A number of interesting varieties are found in the canal. The absence of any particularly good lakes or ponds makes this species more rare than it otherwise would be; however, it takes advantage of the several mill dams in the district. *A. anatina* seems to be confined to the Leeds and Liverpool canal, where it is fairly common. Of the Dreissenidæ, *Dreissena polymorpha* is exceedingly abundant in the canal. In 1887, when the canal was run down owing to the drought, the walls of the embankments and locks were covered with it. *Neritina fluvatilis* is very local and has only yet been collected in the canal. *Paludina vivipara* is very local and rare for want of sluggish streams or ponds; it is only found at Gilstead near Bingley, and in a ditch at Steeton. *Bythinia tentaculata* is one of the commonest of snails in the canal. *Valvata piscinalis* is in the canal at Bingley, very local; a few specimens have been taken at Malham Tarn. *V. cristata* is not recorded for Airedale. The Limnæidæ are well represented, *Planorbis nitidus* is in the canal and a ditch at Dowley Gap, Bingley. *P. nautileus* type is found in the canal and at Malham Tarn. The variety *crista* is very common in Tong Park dam. *P. albus* is generally distributed in our ponds and ditches. *P. spirorbis* is locally abundant. *P. vortix* is abundant in the canal at Bingley; elsewhere in the valley it is rare. *P. carinatus* is generally distributed. *P. complanatus* is probably absent owing to the want of suitable conditions. *P. corneus* is not a common snail in this district; it is very local; a few in the canal and

Buck Mill Dam, Thackley, where it has been introduced about twelve years ago. *Physa fontinalis* is absent and *P. hypnorum* is extremely local, it only being recorded from Bell Busk; the hilly nature of Airedale does not produce suitable habitats for the *Physa*. *Limnæa peregra* is everywhere; *L. auricularia*, very generally distributed. *L. stagnalis* is very local, being only found in a ditch at Steeton, and in Buck Mill Dam, where it was introduced in June, 1889. Variety *fragilis-variegata* is common at Malham Tarn; the absence of this species in other parts of the Aire valley is due to the want of a suitable home, as it prefers ponds and lakes in which there is plenty of vegetation. *L. palustris* and *truncatula* are generally distributed in suitable places. *L. glabra* is very local, only occurring in Sandals Pond, Baildon Green. *Ancylus fluvatilis* and *A. lacustris* are both found in Airedale, the latter at Baildon along with *L. glaber*, also at Utley in the old river bed; these are the only two known localities. The Terrestrial Mollusca of Airedale compares very favourably with other districts. We have five species of the genus *Arion*, all of which are to be found in suitable localities, *e.g.*, *A. ater*, *A. subfuscus*, *A. hortensis*, *A. bourgiugnati*, and *A. minima*; the latter was added to the British fauna by Dr. R. Scharff, of Dublin, from specimens collected in Manningham Park, October, 1890. Limacidæ are represented by *Limax maximus*, *L. cinereo-niger*, *L. flavus*, *L. agrestis*, *L. lævis*, and *L. arborum*. *Testacella haliotidea* is found at present in two localities only, the gardens, Ferniehurst, Shipley, in 1890, and last year it was found in the gardens of Mr. Behrens, at Thornfield, Frizinghall; and on May 26th this year, Mr. Keighley, the gardener, brought me half-a-dozen specimens from Thornfield, so that it is somewhat common in that place; in all probability it has been introduced with plants in both cases.

The Helicidæ are very well represented in the Aire drainage area. A beautiful whitish green form of Succinia

elegans is common on the canal bank near Steeton, along with the type. *Vitrina* and *Zonites* are very plentiful in the district. Shipley Glen produces most of the species and several interesting varieties; also the moisture-loving Helices, *e.g.*, *Helix lamellata*, *aculeata* and *pygmœa*, also *H. fusca*. There is no better place in the district for the rare snails than this. *Pupa ringens*, *Vertigo edentula*, *V. substriata*, *V. antivertigo*, are all to be found in the boggy places in the glen. *Helix aspersa* is very rarely found off the limestone; it is unaccountably rare in the district. *Helix nemoralis*, *hortensis*, and *arbustorum* occur throughout the valley, especially on the limestone, where they vary very little, compared with specimens collected from Kildwick down to Leeds, on grit formation. All three species are almost restricted to the canal and railway embankments in this area. An interesting collection of varieties can be obtained from between Buck Mill, Thackley, and the lime-kiln, about half a mile lower down the canal, on the embankments sloping into the fields, especially *H. hortensis*, which is in various shades of lilac to olive, and white to orange. *Helix sericea* and *hispida* are very plentiful on the canal and railway embankments; albinos of the latter are not uncommon near Calverley, on the railway banks, in moist corners. *H. virgata* is extremely local—Morton Banks and Cottingley are our only records, although it is very plentiful at both places. *H. virgata* is a roadside snail; with us it is seldom found elsewhere in this district. *H. ericetorum* is almost confined to the limestone; it occurs on a bank by the roadside at Hollings Hill, Esholt, where it has probably been introduced with the limestone for road metal.

H. rufescens and *rotundata* are everywhere; *H. rupestris* is confined to the limestone districts, so is *H. lapicida*, where both are not uncommon. *H. pulchella* is well distributed throughout the district, so is *Bulimus obscurus*. *Pupa secale* is very rare: it is only recorded from Malham; it is very abundant about Settle, the same

formation as Upper Airedale, *Pupa umbilicata* and *marginata*, *Vertigo pygmæa* and *pusilla* are to be found about Malham, also *Balea perversa*, which is plentiful on the limestone. *Clausilia laminata* is confined to the same formation, whilst *C. rugosa* is well distributed throughout the district, as also is *Cochlicopa tridens*, *C. lubrica*, and *Carychium minimum*. *Cyclostoma elegans* and *Acme lineata* are still missing from the Airedale fauna, although there are plenty of suitable places for the latter.

Vertigo alpestris is confined to a garden near Cottingley Bridge, Bingley, where it has been introduced with plants from some unknown locality. Although the district has been well worked no other habitat has been found for it.

10.—METEOROLOGY.

By ALBERT WILSON, F.R. Met. Soc., F.L.S.

The general character of the weather at any place in the North of England depends largely on its distance trom the Sea-coast and on its proximity or otherwise to the Pennine range of hills, which forms a great dividing line extending from Northumberland to Derbyshire, and has a great influence on the weather in its vicinity. Bradford is situated on the Eastern side of this range, about 15 miles from the watershed, and about midway between the Irish Sea and the German Ocean. This position gives to the city a cool and rather damp climate and a relatively large amount of changeable, showery weather. With regard to temperature we find, as would be expected from the hilly character of the district, that the extremes of heat and cold are less than in the low level country to the eastward, or in the Lancashire plains to the west. The absolute minima in winter are higher and the maxima in summer lower. The smoke of the surrounding districts, and of the city

itself has of course some effect in tending to conduce to this result. The most noteworthy point in connection with the temperature of the different seasons is the coldness of the spring season, especially in years when easterly winds predominate during April and May. The sky has a great tendency to be dull with such conditions, owing partly, no doubt, to the effect of ascending currents (although the surface is diversified by many undulations, the general level of the Bradford district falls to the east and rises to the west), but also, we believe, in no inconsiderable degree to the increased cloud-producing effect of the large amount of smoke from Leeds and other manufacturing places to the eastward.

Coming to the question of rainfall, the average annual amount of this (about 34in.) is by no means heavy in the centre of the city, though the number of days on which it falls (190) is large. But the depth is about 5in. more than falls in Leeds, and as we proceed westward it again increases considerably, being 45in. on Thornton Moor, and still more on the moorlands beyond.

The relative amount of rain that falls with easterly winds is, we believe, largely in excess of most other places. This is due to the fact, as before stated, that Bradford is situated on rising ground, midway between the low country and the hill summits to the west, consequently the ordinary ascending character of the easterly currents commonly existing when centres of low pressure lie away to the southward is thereby considerably increased, and the precipitation of rain is correspondingly greater. At times the rainfall with these winds is very heavy. As an example, the record of 3·43in. (at Merton Road) in twenty-four hours on October 14th—15th, 1892, may be mentioned. With westerly winds the converse is true, as they are descending currents, and the diminished rainfall towards Leeds with these winds is generally very marked.

As regards bright sunshine, we are not particularly

blessed in Bradford, especially during the winter months. The centre of the city is in a hollow, with high ground rising on every side except one, the narrow valley of the Bradford beck, which joins the Aire at Shipley. The effect of this configuration of the ground is that whenever the weather is calm, and more especially during anticyclonic conditions in autumn and winter, the tendency to the production of fog is very great. In such states of the weather the smoke settles down over the city, and at times produces fogs of the densest description, and accompanied by a darkness even at mid-day the like of which is hardly to be found elsewhere in the kingdom.

We are unable to treat here of other points of interest, and we fear that we have drawn rather a gloomy picture of Bradford weather. It *can* be fine sometimes, however, and we will hope that during the visit of the British Association the sun may shine with a continuance seldom known, and the atmosphere may at the same time have that cool and bracing freshness so characteristic of our West Riding.

V.—A BRADFORD ITINERARY.

By JOHN H. HASTINGS.

Eight and seventy years ago Edward Baines wrote :—"In Bradford, as in almost every other manufacturing town of the West Riding, the inhabitants have of late years suffered considerable annoyance from the smoke emitted from steam engine furnaces, and they look forward with some impatience to the removal of this increasing nuisance, which may so easily be effected." The population of Bradford was then but 13,000 souls, and its factories few. To-day, population and factories are twenty times as many ; and it is matter for regret that Mr. Baines did not leave behind him his prescription for the "so easy" cure of the smoke nuisance. He wrote too "That the town is pleasantly situated at the junction of three beautiful and extensive valleys," but now, who realises that under our streets and amongst our massive piles of masonry three streams which form the Bradford beck still flow. If the atmosphere has grown more and more smoky, so have the streams become more and more polluted as time has passed, and lovers of the picturesque must feel inclined to join in the exclamation of Dr. Whitaker regarding a neighbouring town :—"Before the introduction of manufactories the parish did not want its retired glens and well-wooded hills. The clear mountain torrent now is defiled, its scaly inhabitants suffocated by filth, its murmurs lost in the din of machinery." It was, perhaps, not wholly a misfortune that the City Fathers of the last generation hid the becks

from view and imprisoned their effluvia under the well-paved streets.

The vale of Bradford, with its three heads, is shut in on all sides, except to the north, where its beck finds an exit to join the River Aire, by hills that in a less rugged district might be called both high and steep. Its beauties are now not those of nature, but the architectural creations of man, and the blots on its once beautiful surface are also the work of the human builder. We can only picture to ourselves what it may have been like a century ago by wandering into the neighbouring dales, where the blight of industry has touched the country with a gentle hand.

Let us first take a look at the high ground west, south, and east of Bradford, the scientific frontier of which, on this side, is the water-shed dividing the streams which feed the Aire to the northward, from those which go to dilute, or to deepen the blackness of, the Calder further south. Everywhere factories, dyeworks, and other signs of the busy life of the place. Whether we wander up to the ancient village of Thornton, or to Wibsey, Bierley, Bowling and Laisterdyke, the story is the same, on all sides signs of the local trade. Even Queensbury, 1100ft. above sea-level, has a palatial mass of "mills." All this high ground has in days gone-bye had its picturesque features, but the discovery of coal and valuable seams of iron-ore at Low Moor and Bowling, and the gradual extension of the worsted industry —bringing in their train tall chimneys, forges, furnaces, and hopelessly ugly rows upon rows of smoke-grimed cottages— have robbed it of its charm. Bowling Hall, the head-quarters of the Earl of Newcastle after the battle of Atherton (or Adwalton) Moor, and during the siege of Bradford in 1643, Bierley Hall (the former Elizabethan, the latter late Stuart), and a few other good specimens of old domestic architecture have survived the invasion, but they are hardly cause enough to detain us on this side of the city.

Bradford's true hinterland and sphere of influence are

away to the north, in the valley of the Aire, from Kirkstall upwards—over breezy Baildon, Hawksworth and Rumbald's Moors, including Wharfedale from Otley to its head –and even the head of Ribblesdale—Ingleborough, Whernside and Penyghent. If Leeds disputes our sole right to so much territory, let us at least maintain the "open door," and an equal right to wander freely from Calverley to Malham, Clapham and Ingleborough; from Ilkley to Arncliffe and Penyghent; and from Haworth to Bolton Abbey and Beamsley Beacon. A general sketch of this most interesting and unique tract of country is more particularly the scope of the present paper.

First let us look at the wild country about Ribblehead. As we stand by the source of the Ribble, we have the fine escarpments of Penyghent and flat-topped Ingleborough, and the great mass of Whernside grouped around us. These hills may perhaps not appeal to the soul or imagination of the Alpine climber, but they have a great fascination for the ordinary man, and if the ascent through bracing mountain air, over the fine grassy turf, beloved of sheep, of the limestone base, across the heather of the higher ground be not—like virtue—its own reward, the view from the grit rock summit of any of these hills, far away overland, and eastward out to sea, will amply repay the tourist's toil. Descending, we may explore the marvellous caves and swallow-holes or "pots," which honeycomb the limestone foundation of our three great "fells," as the Yorkshireman, retaining the name "fjelds," given them by remote Norse ancestors, still calls the rugged hills of the West Riding.

At the base of Whernside several caves penetrate far into the limestone, but "the passage is incommodious," as an old writer puts it. The great Ingleborough cave, near the charming village of Clapham, is the best known, and perhaps the most extensive in the district, about 700 yards long. The innermost parts are the finest, and they possess many stalactites of extreme beauty, some uniting with the

stalagmite of the floor of the cave in semi-transparent spar-like columns. Deposits of pebbles and sand are met with in the cave, brought down by an underground torrent—perhaps from Gaping Ghyll Hole, which is a marvellous "pot" on the mountain-side above, of a depth of more than 300 feet, into which a considerable beck flings itself. It was first descended about four years ago by the celebrated French Cave Explorer, M. Martel, and more recently by members of the Yorkshire Ramblers' Club.

It is impossible in the space allowed to do more than mention the magnificent and picturesque chasm of Hellen Pot, east of Ingleborough, or Hunt Pot and Hull Pot on Penyghent's slopes; but before leaving this region of marvels, Chapel-le-Dale between Ingleborough and the southern slopes of Whernside must be referred to, if only because Southey in his "Doctor" makes it the home of the Dove family, and writes a charming description of its tiny church. In Chapel Dale, moreover, is Weathercote Cove, another deep "pot," in which 30ft. from the surface of the ground, in full light of day, a "stupendous subterranean cataract" falls sheer 60ft. into the abyss—"the most surprising natural curiosity in Great Britain!" The water of the Chapel Dale Beck passes under ground through Gate Kirk Cave (another very "incommodious" passage) in this wonderland.

We must leave the marvels of Norber with its perched blocks ice-borne, in distant ages from Shap Fell, and glancing at Giggleswick, a quaint old world town, with a church of some interest, and a celebrated Grammar School; and Settle, another ancient town of some interest and picturesqueness, again turn to the natural scenery. The magnificent limestone scars or cliffs on the line of the Craven Fault claim our attention. There is a fine range of them on the Giggleswick-Clapham road, rendered doubly picturesque by the woods clothing their base. (Here the curious natural phenomenon of an ebbing and flowing well

is to be seen). East of the Ribble the Scars are of wonderful grandeur in the amphitheatre of Attermyre above Settle, and particularly at Malham and Gordale near the source of the Aire. The wildness of the scenery is most impressive, and the pedestrian, who explores these regions, will never regret his toil.

Behind Attermyre is Victoria Cave, the scientific exploration of which, begun in 1870, and largely helped by the British Association, yielded most interesting results. In it were found traces of habitation by man in the days of the Roman occupation of Britain, and, from days of older and remote antiquity, bones were found of the hyæna, bear, reindeer, elephant, and bison, which all had their habitat here before the great ice sheet of the glacial period covered the land and sculptured its contours.

Passing over the high ground towards Malham, we are on the water-parting of Ribble and Aire. The former now wanders regretfully out of the region here described, and slowly—even sluggishly, in the flats near Longpreston—creeps on to Hellifield and Gisburn, and so (through much lovely and unlovely scenery) to the sea at Preston—its wild cheery, dancing stream, from Ribblehead to Settle, with the fine fall of Stainforth Foss—the energy of childhood and youth—forgotten.

The grassy roads of the high ground we are traversing in imagination on the way to Malham, are shut in by rough limestone walls, and the rugged grazing land with its dingy mountain sheep and unkempt mountain horses, is "enclosed" by a network of the same endless walls of limestone—by whom built, who can say; and why—unless to clear the country in part, of the limestone rock which crops out everywhere, and over great tracts appears as a pavement, brocaded with cracks and crevices, in whose cool dark depths the hart's tongue fern flourishes, its leaves growing to a great length in their efforts to reach air and light.

Malham Cove is a great and almost perpendicular lime-

stone cliff, 280 feet high, from the foot of which the River Aire emerges a full, clear, sparkling stream. What subterranean channels the stream has followed, or whence it really springs, is one of those mysteries in which the country of the limestone is so rich. Some Rider Haggard may build a romance on it. Recent scientific tests have disproved old theories and the question is still *sub judice*. Probably some of the water of Malham Tarn, the wild and secluded lake on the "fell" above, may find its way beneath the cove. We may well wonder how in this "porous" country, a lake exists at all; but geologists have shown that "the shallow basin of the tarn is in reality excavated, not "in the limestone, but in Silurian slates which are here "exposed along a narrow strip of ground, bounded on the "north by the base of the limestone, and on the south by "the North Craven Fault, which carries the Silurian rocks "and overlying limestone down several hundred feet." To the great displacements of the Craven Fault, the striking scenery of this part of Craven is due. "In the time of "floods," we read of the cove, "the vomitary is not of "sufficient capacity to discharge the waters, which rise up "to the summit of the rock, and pour down in a stupendous "cataract superior in depth, and little inferior in grandeur "to the falls of Niagara"—but we confess we have never been fortunate enough to see Malham Cove in such very wet weather.

Gordale Scar is the other wonder of Malham—a great gorge in the limestone cliffs, which here are more than 300 feet high, and overhang their base as much as ten yards. In this gloomy chasm a stream, Gordale Beck, comes dashing down a series of falls, and "gives life to a scene, "which would otherwise be almost too oppressive." Indeed old writers were much impressed with its awfulness.

> "Gordale Chasm, terrific as the lair
> "Where the young lions couch,"

writes Wordsworth. "I stayed there, not without shudder-

"ing, a quarter of an hour," says the poet, Gray. "Mais nous avons changé tout cela"; and it is evident from the demeanour of the ordinary Saturday excursion party, that the popular attitude differs considerably from that of the poets.

A mile from Malham is Kirby Malham, a small village ensconced among the limestone hills, with an interesting, not over-restored church, in the register of which is the signature of Oliver Cromwell, as registrar probably, or witness, to a marriage. He may have officiated as a magistrate, possibly while on a visit to General Lambert, who was Lord of the Manor of the neighbouring hamlet of Calton.

The scenery becomes less wild and grand, but perhaps more beautiful, as we approach Eshton and Gargrave, which lie between Malham and Skipton. The River, "has such a winding course" (says Camden) "through the ings between "this and Skipton, and sports so in meanders from its very "source, as if it were undetermined almost whether to run "to the sea, or back to its source."

Eshton Hall, the residence of Sir Mathew Wilson, contains the great library of Miss Richardson Currer, and many fine pictures (Rubens, Vandyck, Rembrandt and others). The fine range of hills, Flasby, Sharphah and Thorlby fells, forming a striking feature in the landscape for many miles around, make, with the Eshton Woods, a picture not easily or willingly forgotten.

Skipton's interesting Castle, with the word "Desormais," the motto of the Cliffords, in open letters of stone over the gateway, dates back to the reign of Edward II., and has a long and curious history interwoven with the Clifford family –the "old Lord Clifford" of Shakespere, the "black-faced" Clifford who fought at Wakefield, the "Shepherd Lord," and Lady Anne Clifford. It withstood a three years' siege by the Parliamentary troops, 1642-1645. The Parish Church of Skipton is also closely connected with the Cliffords, several of whom were buried here, as their tombs

and brasses attest. The wide main street of the town, an open cattle market on Mondays, leading straight to Church and Castle, gives a good view of these, the town's most picturesque and interesting monuments. Through Skipton, Cromwell marched from Wetherby and Otley to fight the battle of Preston.

In which direction are we to continue our explorations? The inevitable temptation is to strike northward or eastward into the lovely dale of the Wharfe; but perhaps we had better first follow Airedale a few miles further—though soon now its stream begins to be polluted—to the manufacturing towns of Keighley (really on the Worth, a tributary of the main river of the dale), to Bingley and to Shipley, before refreshing ourselves in the pure air and among the beauties of Wharfedale. Every two or three miles we find a grey stone manufacturing village or town. In Skipton and Carlton, cotton spinning is the chief industry, but further down the dale and in the valleys which branch out from it, the manufacture of worsted goods gives occupation to the people for twenty miles. Keighley, has in addition an important machine making industry; and the model village of Saltaire, built by the late Sir Titus Salt, Bart., arose out of the alpaca manufacture, which the founder of the village originated.

Haworth, in the Worth Valley, a dreary, black-looking village, about four miles from Keighley, is another important manufacturing place, which the energy and enterprise of two or three families has raised from the wretched little village it was in the Brontës' days to its present greatly increased importance. From the writings of Mrs. Gaskell, Mr. Wemyss Reid, and others, Haworth, the home of the Brontës, it is too well-known to need description here. It is an ugly but characteristic specimen of the dale manufacturing village, and it is difficult to subscribe to the description of it by the latest writer on this country side:—"Just three places there are," he says,

"that impress on one the same atmosphere of singularity and charm; one is Clovelly, the second Edinburgh, and the third is Haworth village, as seen from the middle of its street." It is a place of pilgrimage; but why should admirers of the wonderful genius of the Brontës, in their enthusiasm, clothe Haworth with a halo of beauty, which never hung over it—when they lived in it who made it known to the world—and which would never be revealed to a visitor who had not for rose-coloured spectacles his worship of the talented family of authoresses? Here we have entered upon controversial ground, which was far from our intention, else we should have discussed the date of the foundation of Haworth Church (fondly believed by the old people to have taken place A.D. 600, before the introduction of Christianity into Northumbria), or the original purpose of the Runic Stone at Bingley, and the meaning of the inscription it bears. Limits of space fortunately prevent this.

At Kildwick is a fine old church, the "lang kirk of Craven," so named because nave and chancel being of one width; the length, which is considerable, seems perhaps greater than it really is. It contains the effigy of a Crusader, Sir Robert de Styveton or Steeton (died 1307). The church, the foundation of which dates back to Saxon times, its old bridge built by the Canons of Bolton, in Edward II.'s reign, and the picturesque old Hall, (17th century), make this small village one of the most interesting in the dale. Keighley and Bingley, like so many others of the West Riding towns have old Parish Churches, but little else remaining of antiquarian interest, the march of progress and industry having transformed charming little villages of antiquity into large smoky towns with many-storied factories and smoke-emitting tall chimneys.

As we descend Airedale from Skipton, we have on our left the great range or ridge of Rumbald's Moor, so named from William de Romillé, the first Norman Lord of Skipton,

a noble stretch of heather-clad moorland, with many grand escarpments of Millstone Grit—which rock tops the hills, and ever and anon crops out in fine broken craggy edges. These moors rise to a height of 1330 feet above sea-level. On our right, wild, rough hills extend away to the borders of Lancashire, and include the "dun and purple moors" of the Brontës.

The rocky edge overlooking Bingley with its "Druid's Altar"—"which has only received that name in these last few years"—commands a magnificent view of the valley and country around and beyond, embracing on a clear day even Ingleborough. We have many traces of antiquity on these rugged hills. Behind the "Druid's Altar" on the estate of Mr. Ferrand of St. Ives, with its charming woods, are graves of Cromwell's soldiers—"a burial place in the centre of the encampment of Parliamentary troops, which for several years were commanded by Sir Thomas Fairfax, of Denton, near Otley." On Silsden Moor we find a Roman camp. On Baildon Moor, a detached hill or spur, south of Rumbald's Moor, are stone circles, cairns and barrows, remains of a remote period in the history of this country; and on many of the table-like rocks of the main hill, we find "cup and ring markings" and weird signs, relics of a far distant heathen age, such as are found in like situations throughout the world.

One feature of Airedale, the Leeds and Liverpool Canal, must be noticed before we stroll over Rumbald's Moor into Wharfedale. James Brindley, the great Canal Engineer of the last century (the 18th) surveyed and laid out this canal, but was unable to undertake the construction, which was begun in 1769. "From Bingley and about three miles down," said a writer at the opening of the Canal, "the noblest works of the kind that perhaps are to be found in the universe are exhibited, namely, a five-fold, a three-fold, a two-fold and a single-lock, making altogether a fall of 120ft.; and a large aqueduct bridge of seven arches over

the river Aire." The universe has progressed since 1769. The canal, however, especially in ante-railway days contributed greatly to the development of the prosperity of the district.

Just above the "Seven Arches," as the aqueduct is named, the river Aire, "instead of cutting through Hirst Wood, bends sharply back, and after a second abrupt turn, flows through a confined gorge, which opens into the principal valley lower down. Putting the local facts together, it appears that the river course was once nearly straight, but that by glacial deposit . . . the channel became obstructed with drift. The stream was thus deflected, and forced to cut itself a new course."

We may take a rapid run through the busy town of Shipley, and a peep at the charming park of Esholt Hall, with its fine avenue and woods (but alas! the now filthy Aire running through it), and at the pretty residential district of Apperley Bridge and Rawdon; a glance also at Calverley with its ancient church, before travelling over to the beauties of upper Wharfedale.

Like the Aire, the River Wharfe rises in the high ground, which divides the waters of Lancashire from those of Yorkshire. A glance at the ordnance map would show more clearly than ten pages of descriptive writing the arrangement and courses of streams. Langstrothdale Chase—

". . . . . Strother,
Ffer in the North, I cannot tellen where,"

as Chaucer names it, is a two-headed dale; and in the northernmost branch, the Wharfe proper rises. The stream flows between wild moors, "gradually sweeping southwards, and cutting its channel deeper and deeper through the rocks." Soon the "brown moors, ill-drained, clothed with heather, sedges and moss, and strewn with grit boulders, separate a little on either hand, and disclose a narrow glen with precipitous rocks, bright green pastures, and scattered

trees," and we are in the region of the mountain limestone. We pass through the old-world village of Kettlewell, almost overshadowed by the great masses of Buckden Pike and Great Whernside, and soon the River Skirfare, coming down through the charming village of Arncliffe from Penyghent, joins the Wharfe.

The limestone "which in Langstrothdale was exposed only towards the bottom of the valley," is seen cropping out in crags and lines of grey rock high on the steep hillsides, and 3 miles below Kettlewell, we have the magnificent Kilnsey Crag, like a great sea cliff of white or grey limestone, 170ft. high, and overhanging its base some 40 feet. A sea cliff, Professor Phillips believed it to have been; but later geologists hold that atmospheric causes, rain, frost and streams give a more satisfactory and acceptable theory to account for this, perhaps the most magnificent crag or scar in Yorkshire, which "as a feature in landscape has greatly the advantage of Gordale Scar." Between Kilnsey and Arncliffe is Dowkerbottom Cave, in which, in addition to remains of animals extinct in Britain, were found three human skeletons, with antique ornaments and weapons of bronze, and Roman coins, etc., throwing open a vista of a remote past in the life of these dales of which no ancient writings exist to tell the story. From Kilnsey to Grassington the river is everywhere alive and beautiful; the rapids or narrows known as the Ghaistrills, and the falls at Linton, below Grassington, being particularly fine. The valley is well wooded.

The hill country north of Grassington is desolate and bare, it has not the fine features of the higher parts of the dale, and one feels that it will never be attractive until planted and clothed with woods. It is dotted over with Lead Mines, now no longer remunerative, and what our American Cousins call "shut down," but dating back to a very early period. Probably ancient Britons worked them, certainly the Romans, for in 1735 two pigs of lead

were found near one of the old shafts, bearing the inscription—

"*Imp. Caes. Domitiano. Aug. Cos. VII Brig.*"

which fixes the date as about 82 A.D. (One of these pigs is in the British Museum.)

From Grassington a road leads over the "hause" or "nek," dividing Wharfedale from Airedale, by way of Cracoe and Rylstone to Skipton. The moorland scenery bordering this road is very fine,—the conical Thorpe fells, (said to be old Coral islands,) Burnsall, Cracoe, and Rylstone fells with with their craggy edge, ending in the bold rocky point or "spion kop" of Crookrise, are most impressive. Thorpe or Thorp-sub-montem "is in a most retired situation within a "cavity so encircled by high grounds, that it is difficult to "conceive at first sight how the waters escape and why it is "not a lake"—a pretty and sequestered little place. Rylstone and the Nortons of Norton Tower have been immortalised in Wordsworth's "White Doe of Rylstone."

To go back to Wharfedale, opposite Grassington is the quaint village of Linton with an imposing pile of Almshouses, and a Parish Church dating from Norman or even Saxon days, placed in solitude on the river bank half a mile from its tiny village and parishioners. Burnsall, two or three miles lower down, is one of the most beautifully situated places in the Dale, it is an ancient place with a village green and maypole; and a Church dating back probably to days before the conquest, although as at Linton, much of the structure is fifteenth century. Burnsall Church rejoices in two Rectors, and "each Rector has his own stall and pulpit, "from which the service is alternately performed." The village also has its own poet. The Limestone, of which the features have not been striking for the last mile or two, here forms bold bluffs or scars rising almost vertically from the river; but at Appletrewick, two miles below where the river traverses a fine wooded dell—we leave

the limestone and its magnificent features for shales and grits.

This is not the place to tell the romantic story of "Sir William Craven, Knight and Alderman of the City of London, and late Lord Mayor of the same," another Dick Whittington, who left his native village of Appletrewick under the care of a common carrier, and "returned in such sunshine of prosperity" that Burnsall Church "was repaired and butified at the onlie coste and charges" of this good man, A.D. 1612. His son was created Earl of Craven by Charles II.

The rock-crowned "kopje" of Simon's Seat is a fine and very striking feature of this part of Wharfedale guarding the threshold of Bolton Woods on the left; while opposite, Barden Tower stands sentinel, its gloomy ruin—for it can hardly be called architecturally fine or artistically beautiful—commanding one of the most charming prospects in the district. Originally built for the "accommodation of the keepers and the protection of the deer . . . Henry, Lord Clifford, enlarged it for the reception of himself and a small train of followers." His successors "totally neglected it," and when Lady Anne Clifford, Countess of Pembroke, succeeded to the inheritance (1656 or 1657) it "had layne ruinous ever since about 1589." Lady Anne was a great builder, and restored the tower, which remained entire till 1774. The heather-clad Barden Moors, stretching away to the Burnsall and Rylstone Fells, and to Crook Rise above Skipton, are separated by only a few fields from the Tower enclosure.

We now enter Bolton Woods and the precincts of Bolton Abbey, favourite ground of the tourist, the picnicker, and the day excursionist, known to the world from the writings of Wordsworth, Rogers, Ruskin, and others, and from the paintings of Turner and countless later artists. The woods, by permission of their noble owner, the Duke of Devonshire, are freely open except on Sunday, and

the scenery between Barden Bridge and Bolton Bridge, where the Wharfe runs through a "deep-wooded ravine is of the 'finest and most rememberable.'" At the Strid the river narrows in a channel of rock to a width of three or four feet, and rushes and roars, whitened with foam; or in times of flood covering the rocks, which ordinarily imprison it, it dashes a wild waste of broken water over its rugged bed. The "Valley of Desolation" and the Deer Park above it, and a thousand perfect views and peeps, would detain us long, but we must move on to the Abbey or Priory, as it is more correctly styled.

The original monastery was founded at Embsay, (between Bolton and Skipton) in 1120, by the Romillé family; but thirty-three years later "the canons were removed to Bolton" by William FitzDuncan and Cecilia de Romillé, his wife, whose son, the "boy of Egremond" was drowned in the "Strid" in Bolton Woods. The sad death of the youth was, tradition, the cause and occasion of the transfer of the Priory to Bolton. Readers of Wordsworth are familiar with his poem based on this tradition. When the tidings of her son's death were brought to the good lady:

> "Long, long in darkness did she sit,
> And her first words—'Let there be
> In Bolton on the field of Wharfe,
> A stately Priory.'
>
> "The stately Priory was reared;
> And Wharfe, as he moved along,
> To matins joined a mournful voice,
> Nor failed at evensong."

Unfortunately this pretty little story has been disproved by the ruthless archæologist, who shows that Cecilia de Romillé gave Bolton to the Canons of Embsay in exchange for their manors of Skibedon and Stretton, a mere commercial transaction, to the deeds of which "the boy of Egremond" himself attached his name as a witness.

Very little is left of the Abbey, except the church. The

nave has never ceased to be used as a Parish Church; but at the Dissolution the chancel was rendered ruinous, nearly all its windows have lost their tracery, and as we admire that which remains, we can only regret the destruction of so much beauty. The graceful arcades (early English) on the walls of the chancel will not fail to attract the visitors' notice. A ("perpendicular") tower was begun at the west end of the church in 1520, by the last Prior of Bolton, and left unfinished at the Dissolution. "The curious" will also visit the old "hospital" or almshouses for widows at Beamsley (half-mile from Bolton Bridge), founded in good Queen Bess's time by Margaret Clifford, Countess of Cumberland.

The whole scene at Bolton is one of the greatest beauty —river, rock, wood and meadow a perpetual delight. Interesting geological sections abound in this neighbourhood: the contorted strata of shale in the "purple" rock rising vertically from the river opposite the east window of the Priory; and the fine anticlines and synclines in the limestone quarries near Bolton Abbey Station and in Draughton village, are perhaps the most important.

Now we make our way down the valley through Addingham "Long Addingham" of the ballad, whence many lusty and stalwart men accompanied Clifford to Flodden,—to Ilkley, the Olicana of the Romans.

Ilkley seems to have been a "station" on the highroad from Mancunium (Manchester), to Isurium (Aldborough). The foundations of the Roman fortress are traceable on the riverside, and many Roman remains have been dug up,—brick, glass, pottery, altars, tablets, etc. Camps of Roman origin and perhaps British also, have been found on the neighbouring moors. Of later antique times we have at the church several memorials, notably the three shafts of Saxon crosses, covered with quaint sculptures, and the effigy of Sir Adam de Midelton (temp. Edward II.), if indeed it present this worthy, for in this case he must have worn armour of

old fashion, the effigy being clad in the mode of an earlier period. The Midelton family still own the estate on the north of the river, and until recently resided at Midelton Lodge, on the hillside opposite Ilkley.

Dwellers in the upper part of Ilkley can step from their gardens on to the wild moor, with its great rocks—the "Cow and Calf," the valley of rocks, the "panorama" rocks and so on—and its streams and springs of pure and medicinal water from which the town obtained its reputation as a hydropathic health resort. Great and handsome edifices have been erected for the "water cure," and still flourish,—the number of visitors to Ilkley still increases, and the picturesque village of forty years ago, with an open beck flowing down its "main street," is now a large town.

Here our itinerary must end, but no account of this region would be complete without some notice of the part which it plays in the work-a-day life of Bradford. Endless miles of conduits bring water to the city from Thornton Moor, Barden Moor and Silsden Moor, where capacious reservoirs collect the rains of heaven and the out-flow of innumerable springs. Even further afield Bradford has gone, and another mighty "lake" has come into being in far off Nidderdale, ten miles north of Barden.

VI.—THE ROMANCE OF WOOL.

By HALLIWELL SUTCLIFFE.

Romance knows no boundary-walls. Open moor or wooded valley, mill or crowded street—we meet her everywhere, for everywhere we carry her with us. None can define romance, few can fail to know her when she comes; for each of us in his own degree is a magician, who by some God-given alchemy of the mind has power to make a golden wonder-land from the hard stone of fact.

This world of Bradford, now. Nothing is easier than to stand on a pinnacle, and look down upon the grime of it, the uproar and the fret to let one's ears be deafened by the hurrying looms, one's courage daunted by the huge, brute squalor of it all—to deny that here can be any note to stir the deeper harmonies. Nothing, on the other hand, is easier than to come down from our pinnacle—a cold and obvious situation, after all—and to move among the undercurrents of that life, and to go back, step by step, from the present overwhelming vastness to the individual life-stories that went to the making of it all. Once history is touched—the history of Bradford trade—once we can trace the rills and rivulets of quiet endeavour that have gone to the making of this roaring stream of trade—lo, romance is with us ere we know it, and fact grows poetry.

It seems a commonplace—a rather dull commonplace, in fact—to say that Bradford is the centre of the worsted industry. But is it a commonplace? Not long ago this Bradford was a village, scarce known beyond its own

boundaries: is growth a commonplace, or are the struggles and ambitions of a city's adolescence less thrilling than the story of a strong man's rise to greatness? Worsted, moreover, is woven from wool, and it is round wool that the prosperity and civilisation of the world have centred since Rome was the master-power, since Carthage queened it on the Mediterranean shore—nay, since the Patriarchs measured opulence by their sheep that grazed upon a thousand hills.

Wool, in fine, is too romantic a commodity — too romantic, that is, unless one had a dozen closely-printed volumes in which to tell its story. Whenever we touch history, we find the glossy fibres of the fleece close-woven into its fabric. In ancient Greece it played its part; in the history of mediæval Europe it occupied an honoured place. Many men since Ulysses' time, indeed, have been concerned as to the length of a woollen fleece, but surely none have had so keen and personal an interest in the matter as had the old World-Wanderer when he escaped from the Cyclop's cave by clinging underneath the belly of a ram. Bruges, with its poetry, its grey, memorial dignity, owed all its old-time opulence to wool; and foreign princes, when they tarried in the city, were dazzled and amazed by the magnificence of this town which was as surely a Wool City as Bradford is to-day. Spain did not scruple to make the Golden Fleece the symbol of a high order of chivalry; and trade, before ill-breeding masqueraded here in England as worthy pride, was looked on as a fair and an honourable occupation for any man. It is astonishing, indeed, that England, whose instincts have always been commercial, should ever have harboured the false doctrine that trade soiled the hands; she never would have harboured it, but for the coming of a foreign line of monarchs to her throne, and the introduction of habits, of taste and thought, which were in no sense English. It is strange, too, that the Spaniards, with all their love of more theatrical romance,

have grasped what we English have been slow to do of late —that wool is touched with the halo of true poetry. The feet of the sheep are golden, says the Spanish proverb ; and this is more than a poetic way of saying that there's good money to be earned by selling fleeces ; the proverb indicates a whole new outlook on the dignity of trade, and makes of trade's profits a something fairer, a something saner and more eloquent, than the harsh chink of coins into a miser's coffers.

Trade prospered here in England, though, whatever opinion polite society might hold of it, and trade to-day has won acknowledgment of what has always been the underlying fact—that England's patron-quadruped is neither the lion nor the unicorn, but the mild-faced sheep.

If romance is what we seek, we can turn the pages where we will, with fore-certainty of success. What of Jack of Aylesbury, for instance, the merchant-prince, who owned a hundred looms, and who, when the Northmen marched to fight the Scotch on Flodden Field, equipped and led his hundred weavers to the fray? Shuttle and thread came readier to their hands than martial tools : but they tell us that our five-score men of wool acquitted them like men in a battle that was not lightly won. There's a song, there, if you like —the Weaver's Marching Song —or, if you will, a drama, with hum of the loom and screech of the reeking battle so intermingled that a man, having hearkened, shall not know which is uppermost, the note of toiling peace or the note of hot and bloody conflict. But this he shall know—that these hundred weavers, marching with set faces and hearts that patient toil have toughened, are proof of a sure fact, and that labour can learn from peace the lessons which, if won from war, are reckoned honourable.

Nay, fight has been the key-note of the wool-trade ; not one quick march, a hot and sudden victory, but the long struggle against enemies unseen which of all warfare is the

hardest. How can we help but warm to the splendid battle-story of the trade, its staying power, its carelessness of all the odds against it? Now buffetted by the State, now spoiled by flattery, a more dangerous foe than harshness; at one time taxed so heavily (to maintain the mistresses of a Sovereign, or to support his warlike play), at another protected so carefully that the State ordained that all corpses should be buried in woollen shrouds; harassed, blown upon by cold winds and by over-warm, this wool-trade struggled on—on and upward, until it proved itself the world's conqueror. And the road along which a fight so stubborn and prolonged was waged could not fail to give us many a wayside flower of romance such as blossom in the wake of last year's battles.

Marsden's story, for instance. A tradesman's son, this Marsden, born within touch of Bradford here, and destined one day to be the founder of Australia's prosperity in wool. While learning his father's business, he worked hard at his books, and saved his pence; and in due time he pushed his way to Cambridge; from there he went as a missionary to the convict settlement in Botany Bay; struck by the aimlessness of the convicts' lives, he saw that the one sure road to godliness was through honest and productive labour; he encouraged them to till the ground, and to breed sheep; and when he next came home to England he brought with him a few stones of the wool so grown. He took the wool to a manufacturer-friend of his, persuaded him to see what could be done with it, and secured a promise of the first piece of cloth woven from the yarn. The cloth was so much to his liking that he had a suit of clothes made from it; and the suit pleased him so abundantly that he must needs write to King George the Third and beg an audience, in order that His Majesty might see the new wearing-gear. The King received him, ordered a suit of the same stuff, and presented him with five sheep from the royal flock, with which to improve the Australian breed: and Botany wool became an

established article of commerce through the efforts of one who, but for a singular genius for self-help, would have finished his days beside a smithy-anvil.

Marsden, tradesman's son, parson, and apostle of the creed of self-help, is a characteristic product of his times. Arkwright had invented his spinning-frames, and the power-loom had emerged in a crude form from its creator's brain; but invention was only at the beginning of its conquests, and everywhere fresh worlds of enterprise were opening. It was the early manhood of our present commerce, and it showed all the qualities of adolescence—high spirits and high disregard of odds, and energy that faltered only to be renewed again from an unfailing spring. It is a period that allures and chains one; and its charm is the charm that the Viking stories give us, the tales of Drake and Hawkins and Raleigh. Everything was possible in this new world of invention, just as everything had been possible to the sea-riders of Elizabeth's day. For untold generations there had been little change in the fashion of combing or of weaving fleeces; and now, on the sudden, there had come a great awakening. A new thing under the sun was to be created, in spite of the written wisdom of many men since Solomon; there was no tradition to hamper, if there was none to inspire; men saw the goal only, and aimed at it each in his own fashion. To frame a thing of wood and steel that should do man's work for him—to shorten the hours of labour and yet increase the output of such labour—this was the goal. If there were drawbacks to the coming of machinery, they were not even guessed at by the pioneers; they had nothing to do with what came after Big Ben and the power-loom; their vision had the keenness, yet the narrowness, which is essential to all such stupendous achievements, and because the invention of such machines was to them the inauguration of the millenium, they laboured with a tirelessness that had in it a quality Homeric. Cartwright showed what could be done,

and after him the roll of stalwart fighters grew with marvellous quickness. Heilmann and Lister, Donnisthorpe and Holden—men who lived such lives of self-sacrifice, frugality and labour as we of to-day do not clearly realise—such lives as bear witness that trade has its heroes and its zealots as surely as the church and battlefield.

Cartwright, for instance, whose claim to the fatherhood of modern invention has been freely and generously admitted by those who followed him. A country parson, busy with his glebe, his wife, his children growing faster than his purse—a man of letters, who had written verse as bad as any of the lions of his day could boast—what was he doing with machinery? Why, nothing, until he chanced to be dining in Matlock one day and overheard a knot of business-men discussing spinning-Jennies. Cartwright, who had a lively interest in discussions of all kinds, listened to their talk and found them unanimous in their opinion that the machines were bad in tendency, inasmuch as they spun wool and cotton fibres faster than the hand-looms could weave them into fabrics, and so too much English yarn was being exported for the foreigner's benefit.

"That must be altered, then," said Cartwright, breaking into the talk.

They glanced in surprise at the stranger, with his air of smooth gentility and his rusty parson's gear; and he—remembering, perhaps, that fools gain entrance now and then while angels dally on the threshold—put arguments before them. The spinning-Jenny could not be recalled; then the suggested evil must be met in another way; machinery for weaving must be invented, so that the yarn could be used as fast as it was spun.

"Impossible!" cried all the merchants in one breath.

"Nay, possible -and I will show you how," said Cartwright.

And he did. He went home and set himself to the consideration of a matter which, four-and-twenty hours

before, had never crossed his field of view. Unskilled in mechanics, a stranger to all details of the tools he used, he rose above the merely impossible and achieved what was, in any well-balanced interpretation of the word, a miracle. There is always poetry in the forlorn hope, whether a Stuart laddie leads it to skirl of pipes and swing of kilted Highland limbs, or whether a country parson heads it, working dimly amid the silence of wood and field towards a goal whose brightness dazzles him. At forty-one he had all to learn, of beam and shuttle, crank and rods and screws; at forty-two he had produced a machine which, if crude and unperfected, performed its work. He had done what he set out to do, what in a moment of very midsummer madness, as it seemed, he had promised to those merchants in a Matlock tavern: and he had proved beyond a doubt that wood and steel and driving power could, in fact, supplant the labour of men's hands.

The date of Senlac we all know, because a thick-set man came out of France, landed picturesquely on the coast of Sussex and secured the English crown; the year of the Reform Bill is familiar to us, because it introduced a vital change into our parliamentary system; but why is not this year of 1785—the year that saw Cartwright patent his first power-loom—not fixed as surely in our minds? The conqueror of Senlac changed our history; the conqueror of Tory exclusiveness gave new life to the outworn body of the State; but Cartwright, in the year marked red as 1785, altered the world's destiny. It was no humble stake of islands and of kingdoms that was played for in that lonely country parsonage; and Cartwright, when he won the hard-fought game, took on himself a strange and terrible responsibility. The glory of modern trade and the squalor; its ever-growing restlessness; the suicidal growth of towns at the expense of country, and hand-in-hand with this the increasing physical, and dwindling mental, comforts of life; the wider boundaries of art, the development of a

charity undreamed of by our fathers; all these—the good and the bad close-woven in the chequered piece—have come from the rude loom fashioned little more than five score years ago. Our parson set the shuttle going and clapped his hands, but it moves now with a speed beyond his power to check. Could he come back among us, would it be well, one wonders, with the dreams that spurred him forward to the enterprise? Not very well, perhaps, for he would find that even yet we travel slowly, and with no compensating surety, towards that Millenium which he foresaw.

A strange destiny, Cartwright's; strange too, in the hardship and the dignity of its sequel. After improving his power-loom, he must needs go on to invent a machine for combing wool, and so mark another epoch in trade's history; his days were full to the brim of effort—and they closed in poverty. Money went in experiments, in defending himself against abuses of his patents; manufacturers, too, were chary as yet of buying the new machines: and he would have died in poverty, had not Government, with tardy acknowledgment of his deserts, granted him a sum of £10,000 in recognition of his services.

There was no lack of disciples to take on his work. Everywhere the spirit of invention was abroad, and men's thoughts, which once had gone a-seafaring, turned all to the new adventure-land. Heilmann and Donnisthorpe, Holden and Lister—a score of eager combatants ran headlong into the lists; and we in Yorkshire have our own pride in the knowledge that Lister and Holden—though one of them was by birth a Scotchman—were the products as well as the stimulators of local trade. It was not far from Bradford here that Holden learned the details of wool manufacture; it was here that he applied himself to work with a tenacity which was conspicuously Yorkshire in itself; and the lessons which he learned in Yorkshire mills helped him to the perfecting of inventions that are memorable even in an epoch of memorable inventions. In Bradford, too,

Lister began in a small business, and prospered, and made a fortune; in Bradford he developed his machine for combing, and lost his fortune, and built it up again, inventing all the while. Enthusiasm, courage, self-denial—he brought a man's qualities to a man's work, and he did more for the development of modern trade, perhaps, than any man who followed him. And not the least of his good works is that he has insisted, with large-hearted generosity, on the debt which he and others owe to Cartwright.

No quality is more essential to romance, perhaps, than unexpectedness, and the working of what seem chance coincidences towards a climax long-desired; and in this quality the more recent history of trade is strangely rich. Cartwright himself is an example. Suppose our country parson had never taken that trip to Matlock, or had dined at a different tavern or at a different time of day? He might—nay, almost surely would—have gone to his grave without the one slight stimulus needed to turn his thoughts into the channel of invention. His mood, the temper of the merchants' gossip, the impulse that seized him to break into their talk—all were the result of a sequence so nicely-balanced as to be well-nigh incredible. No self-respecting author dared have presented such a happy-go-lucky plot in fiction—a plot, moreover, fraught with such momentous issues; for authors are merely men, and narrow-minded; it needs a Providence, a Destiny—call it what you will, there's true romance behind the name—to take up the scattered weft called chance and throw the shuttle fearlessly across the warp of every-day existence, and make therefrom a serviceable fabric. Men, the narrow-minded, still call it chance: but the mills of God go working in the dark, and none can deny the workmanship, though many fail to grasp that before all good patterns must come the step-by-step design. The hum of working cities, the stress and wealth and abject poverty that live upon the looms to-day—are these the children of a blind chance that took a country

parson to a certain Matlock tavern at a certain hour of day? We cannot credit it.

Then, too, if Titus Salt had not wandered into a warehouse at Liverpool and poked about among some rat-eaten bags of wool-refuse and found a use for the fibre which the owners had not thought of, should we have had the alpaca industries of Bradford and Saltaire? And if Lister had not undergone an exactly similar experience in London with regard to a neglected heap of silk-refuse, the biggest silk mill in the world would never have been built at Manningham.

There was Heilmann, too, who discovered the secret of an effective combing-machine while Donnisthorpe and Lister were finding an independent solution of the difficulties. He was wearying of long effort fruitlessly maintained, and he turned from his last plan of the machine in search of some trivial sight that might distract his thoughts. His daughters were combing their long black hair before the glass, and it was not until he had watched them idly for awhile that the thought ran through his brain—what if I can make my machine repeat in every detail the girls' action as they ply their combs? The hint was delicate to the point of vagueness, but it gave him all the clue he needed, and his machine became a fact accomplished.

The history of invention offers us romance, and does not stint us, but the history of the change which invention wrought in the lives of those whose livelihood depended upon trade is in itself as strange a tale and one as full of startling change from light to shade as any the world knows. Suppose we glance at the last century only; suppose also that we move very warily when talking of the working-man's prosperity a hundred years ago, in deference to the widespread fallacy abroad that in all respects he is a happier man to-day than at any other period of his history. Two possessions he had to a certainty then -freedom to work when and where he would, and freedom to suck in the

sunlight and the wind of heaven. Men combed the fleece in their own homes; they wove it there; and lassies spun the yarn at cottage doors, by stream-sides or by garden-ways. The lowing of deep-uddered kine, the song of mavis and of lark, were part and parcel of the woven fabric, and trade was bedfellow to country peace. Men held a sane view, moreover, of their work, regarding it strictly as a means of livelihood: and when they had combed sufficient slivers, or woven cloth enough to satisfy their slender weekly needs, they donned their coats again and went a-fishing or a-poaching, or they picnicked in the wooded valleys, according to their inclination. Because they could keep themselves—ay, and rear families, too—on what seems to us a starvation wage, we assume that they were always on the thin edge of penury; but the exact converse is the case. They were rich in three separate ways—in health, in leisure, and in the freedom from that itch for luxury which is so prevalent an infirmity to-day. They were all-round men, moreover, who could till their bit of land, could rear oats enough to keep them in the healthiest staple diet they could have, could grow their own potatoes and keep a pig or two, a cow or two. All this they did in the intervals of work; and in spite of all their occupations they still had time over and to spare for those excursions with rod or snare which have given the old wool-workers' lives so marked a colour and a fragrance. Their lives, in fact, approached so nearly to the ideal conditions of a Golden Age that there is risk lest a true picture of the times should be discredited; and so anxious are we, on the other hand, to paint the bad old days in the worst colours that all the saving qualities of this Arcadian period are dismissed off-hand as highly coloured fiction. Yet the facts remain, and, though times have been bitter hard with the working man—will be again, as surely as the earth goes round from dawn to dusk—it is a surety that once at least, before machines came in, he lived a life of sane and

prosperous simplicity for which he has been given no equal substitute.

For the manufacturer, too, there was free air about it all. He was perpetually on horseback—he had to ride to upland farms to buy his wool, to put out the raw material to be hand-combed and hand-woven, in the hill-side cottages. He had opportunities—nay, he was compelled—to weave threads of summer skies and winter rains, and wonder of the sweeping hills, into the texture of his life ; and Nature, who is the mother and the educator of us all, not seldom touched the deep note in him that makes for worthiness.

Mark how the cloud, no bigger than a man's hand, came up above the blue horizon, with the introduction of Arkwright's spinning-Jenny. Mark how it grew and grew, till the whole sky was thunder-red, till there was no sound from east to west, from north to south, but the growlings of a populace who lacked their bread. And God knows they had reason for their hatred of the new machinery, for no new order was ever heralded by darker signs. With the first whisper of hasty production, made possible by machinery, came also the restlessness of the masters, the itch to make the uttermost farthing at the expense of any suffering. Children and grown lassies were drawn, little by little, to the factories, and the reign began of such cruelties, such immorality and swinish greed, as makes us to-day draw back from its recital, and shrink as though we felt the overlooker's lash upon our flesh, or saw the thick air of grime, pollution and disease that lay like a plague-cloud over the sites of the new trade. It was not only that the handloom workers lost their means of livelihood ; by the self-same stroke they lost their liberty, their pride, and while starvation mouthed at them from the cottage threshold, they knew that shame of the foulest sort was overtaking their daughters in the neighbouring factory, that their little ones were subject to nameless cruelties.

And if they did not baptise the new trade-era in blood

and fire, the masters had to thank, not their own tactfulness in mitigating the hardships of the new conditions, but the wholesomeness of that very life of which these had robbed the worker. He was an even-tempered fellow, the old hand-worker, take him in the main; he had felt too many winds about his face to lack a certain rough sense of give-and-take; and even at the darkest he understood in some dim fashion that what must be, must be, and that he might as well strive to make the mountain-streams flow upward as to check the advancing tide of ruin. There were good masters then as now, just as in all periods there have been good workmen and bad; but the worst type of master was guilty of enormities which have overshadowed altogether the lives of such conscientious and clean-handed manufacturers as Wood of Horton Mill. When other masters were working children fourteen, sixteen, eighteen hours a day, Wood shortened the working-day in his own mills, at grave risk to his prosperity; and it is to his lasting credit—to Bradford's lasting credit—that the inception of the Factory Act was due entirely to his suggestion. When Oastler, fresh from emancipation of West Indian slaves, came to stay at Horton, Wood pointed out to him the need there was to sweep our own foul places clean, and he gave his guest so grave and circumstantial an account of what went on in the factories of the period, that Oastler commenced at once the vigorous campaign which was to end at last in the passing of the Factory Acts. Cartwright had brought little-expected results to birth by his own inventions; but Oastler's work is not less great, in that he saw the imperfections of the new system and remedied them.

Romance? That period of transition is full of it. The doomed life of the homestead—spinning, combing, weaving, farming—still holding its own beside the gaunt life of the factories. Content and sunlight dying hard, while misery and greed fought the brute fight for mastery. The straight-

set labourer of yester-year growing to a hunched, uncleanly animal, faithless, soulless, hopeless. They had taken his little children and had broken them on the wheel of trade; they had taken his grown daughters and made them lower than the harlots; they had brought disaster after disaster on him, and had robbed him of the meat and drink that were his last allies against disaster. Ay, there's romance in plenty there; but we need a master-pen to limn it. And wool has lacked its master-pens, though wool is greater than the sword.

Then the extinction of the old order, and the coming of our present era, with its different aims, its tension and its stress. The growth of towns, and the steady common-sense of the working-man coming to the front under all changes of condition. The world's wool-market, and trade leaping over seas and continents like another Giant with the Seven-Leagued Boots. Here is surely an epic.

Yet at the end of all—hurry and stress and dreams of a Millenium—what have we done? So little and so much—the little where we looked for great things, and the much where we had looked for small. And that, too, if it is life, is also very certainly romance.

We are proud of Bradford, we who have lived life-long almost within her boundaries; and we are justly proud. Awhile since she was a sleepy village, with a market held once a week hard by the old church-tower; to-day she is the first wool-city in the kingdom, if not of the world. All honour to the lives that have been spent—wear and tear and self-denial—in bringing her to what she is. But there is the future, and prosperity has always been a snare. Perhaps enthusiasm, which is the salt of life and keeps it wholesome, is not so quick among us as once it was; it may be that we have a catch word, "business," and label all the qualities unbusiness-like which made Cartwright and Lister, Donnisthorpe and Holden, and the rest, what they were. We are thrifty, honourable, keen—but do we let imagination

and the ideals of high endeavour rule us as they ruled the fathers of the trade?

The era of invention, with its passion, its single-mindedness, its absorption in the one clear object clearly seen, has left to our generation the legacy of an inevitable reaction. We need to fight against it; we need to see trade whole, to see it worthily, as the world's sovereign, with all a sovereign's responsibilities. Had we a man to-day –a man with a will of steel and a tongue of silver—to preach a new Gospel to an age that is all but ready for it; could a prophet rise up and stand on a Carmel reared among the looms, and tell the people in a tongue they understood, that romance is, has always been, and always must be, the under-note of trade; if such a poet-prophet could come in his full stature and clear the smoke-clouds of mere money-making from the pure air of Commerce, we should see a Renaissance such as the world has never known. The old blood is not sour in us; we are still the folk who three centuries ago awoke to the vastness of the world and brought a swift and hardy recklessness to the opening of new channels for our enterprise; we lack direction only that, and a willingness to let the fair young goodwife, Romance, take up the helm of trade.

The romance of wool! It seems strange that trade has sat disconsolate, like Cinderella, by the hearth, while her sisters, love and war, have danced with the poets all night through. Sword and cross-bow, pistol and long-shafted tourney-lance, have been chosen for the trappings of romance. But what of wool? Kings drew from it the riches which were needful for the sport of war, and by its aid the songs of poets and the pictured dreams of painters struggled to their birth. We had had few feats of chivalry, and yet fewer feats of art, if sheep had never browsed on English soil; for chivalry and art can only thrive on leisure, and it is trade that gives us leisure.

And so the sheep—daft-faced and cowardly, with no more martial zeal than prompts it now and then to run

between the farmer's legs at lambing-time —the sheep stands like another Atlas, with a whole world upon its back. The cannon thunder, and the lions roar, for their little span ; but the looms are humming constantly, and the sheep are bleating, and men are watching the tireless shuttle do the world's work without one plea for honour. And that is very certainly romance.

Yes, of a surety Romance sits at the door of Commerce —sits with her distaff and her wheel, and spins from the glossy wool a thread of richest story. The thread is there —but who will weave it into finished poetry?

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